Influence of Chaining Pinyon – Juniper on Watershed Values in Utah

Project Report

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in cooperation with
Bureau of Land Management

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Title of Study: Effects of Pinyon-Juniper Conversion on Watershed Values in Utah

Objectives:

A. To determine the water budget of natural stands of pinyon-juniper and adjacent areas which have been cleared and/or seeded.

B. To determine the effects of vegetation conversion on soil physical properties and soil stability.

C. To ecologically evaluate sites before and after as to composition and production of vegetation.

D. To evaluate the economics of conversion practices in terms of the watershed values and multiple use relations.

E. To obtain data necessary for determination of hydrologic soil cover complexes on the study sites.

Introductory Comment: This report is concerned with additional data analysis and compilation which has resulted since the project report dated April 1, 1971. As before, the report will provide information to supplement previous reports as well as indicate progress to date.

Runoff Plot Studies: No runoff events occurred at either site during 1971.

Tables 1, 2 and 3 give precipitation data from the Blanding study site. These tables can be summarized on one word --- dry.

Tables 4, 5, and 6 give rainfall data from the Milford study site. There was a complete absence of runoff-producing storms.

Table 1. Precipitation data from 8-inch recording gages at Blanding study site, 1971.

Date	Total Rainfall (inches) Windrow Area	Debris-in-Place
6-11-71	Start	
6-12-71		Start
7-21-71	0.17	0.21
8-5-71	0.26	0.24
8-7-71	0.03	0.02
8-17-71	0.20	0.20
8-19-71	0.25	0.33
8-20-71	0.51	0.53
8-21-71	0.40	0.24
8-23-71	0.03	0.04
8-24-71	0.04	0.05
8-25-71	0.45	0.40
8-26-71	0.45	0.45
8-28-71	0.18	0.23
8-30-71	0.18	0.21
9-30-71	no record	0.55
10-1-71	no record	0.38
10-11-71	OFF Storage gage charged	

Table 2. Precipitation data from 8-inch nonrecording gages at Blanding, debris-in-place area, 1971.

Date	Total Rainfall(inches)	
	Gage A	Gage B
6-11-71 to 6-28-71	0.00	0.00
6-28-71 to 7-10-71	0.00	0.00
7-10-71 to 7-24-71	0.22	0.23
7-24-71 to 8-7-71	0.24	0.23
8-7-71 to 8-20-71	0.53	0.43
8-20-71 to 9-3-71	2.23	2.16
9-3-71 to 9-14-71	0.00	0.00
9-14-71 to 10-11-71	0.93	0.90

Table 3 .Precipitation data from 8-inch nonrecording gages at Blanding, windrow area, 1971.

Date	Total Rainfall(inches) Gage A	Gage B
10-26-70 to 4-3-71	2.20*	
4-4-71 to 6-11-71	0.90*	
6-12-71 to 6-28-71	0.00	0.00
6-28-71 to 7-9-71	0.00	0.00
7-9-71 to 7-24-71	0.18	0.17
7-24-71 to 8-7-71	0.29	0.25
8-7-71 to 8-20-71	0.48	0.45
8-20-71 to 9-3-71	2.30	2.05
9-3-71 to 9-14-71	0.00	0.00
9-14-71 to 10-11-71	0.83	0.90

*Single storage gage operated during this period.

Table 4. Precipitation data from 8-inch recording gages at Milford study site, 1971.

Date	Total Rainfall (inches) Windrow Area	Total Rainfall (inches) Debris-in-Place
6-8-71	Start	
6-9-71		Start
6-11-71	0.14	0.19
7-15-71	0.08	0.08
7-16-71	0.05	0.04
7-17-71	0.13	0.15
7-19-71	0.09	0.08
7-20-71	0.05	0.04
7-21-71	0.12	0.12
7-22-71	0.25	0.22
7-30-71	0.07	0.06
8-3-71	0.27	0.28
8-5-71	0.15	0.14
8-6-71	0.06	0.07
8-8-71	0.03	0.03
8-14-71	no record	0.04
8-15-71	0.10	0.09
8-16-71	0.06	0.03
8-17-71	0.18	0.13
8-18-71	0.70	0.74
8-20-71	0.41	0.46
8-21-71	0.10	0.08
8-26-71	0.22	0.26
8-27-71	0.25	0.29
8-28-71	0.15	0.18
9-30-71	0.25	0.18
10-1-71	0.45	0.45
10-6-71	OFF Storage gage charged	

Table 5. Precipitation data from 8-inch nonrecording gages at Milford, debris-in-place area, 1971.

Date	Total Rainfall(inches)		
	Gage A	Gage B	Gage C
6-9-71 to 6-22-71	0.15	0.10	0.22
6-22-71 to 7-6-71	0.00	0.00	0.00
7-6-71 to 7-20-71	0.37	0.32	0.36
7-20-71 to 8-3-71	0.48	0.45	0.45
8-3-71 to 8-17-71	0.79	0.77	0.85
8-17-71 to 9-6-71	2.05	2.00	2.35
9-6-71 to 9-16-71	0.00	0.00	0.00
9-16-71 to 10-6-71	0.78	0.62	

Table 6. Precipitation data from 8-inch nonrecording gages at Milford, windrowed area, 1971.

Date	Total Rainfall (inches) Gage A	Gage B	Gage C
10-24-70 to 4-10-71	1.10*		
4-11-71 to 6-8-71	3.00*		
6-8-71 to 6-22-71	0.15	0.03	0.10
6-22-71 to 7-6-71	0.00	0.00	0.00
7-6-71 to 7-20-71	0.35	0.31	0.31
7-20-71 to 8-3-71	0.53	0.56	0.54
8-3-71 to 8-17-71	0.87	1.00	1.05
8-17-71 to 9-6-71	1.95	1.95	1.80
9-6-71 to 9-16-71	0.00	0.00	0.00
9-16-71 to 10-6-71	0.89	0.84	0.82

*Single storage gage operated during this period.

Influence of Grazing on Selected Hydrologic Parameters of Pinyon-Juniper Rangeland

Grazing is the major use of the pinyon (Pinus spp.) and juniper (Juniperus spp.) vegetation type in Utah, Arizona, Colorado and New Mexico (Aro 1971). Hydrologic consequences of grazing are determined by the kind and degree of modifications made in the vegetal cover, surface and subsurface soil conditions, and intensity of rainfall characteristics of the area in which the changes occurred (Rauzi and Kuhlman 1961).

Woodbury (1947), Mason (1963), and Aro (1971) reported that overgrazing of pinyon-juniper rangeland has resulted in reduced forage production and increased extent and density of the tree species. Managers of pinyon-juniper range seek to convert these woodlands into more productive grasslands. Public agencies supervising these vegetation manipulation programs are also interested in protection or improvement of wildlife, aesthetic, and watershed values of the sites. This study involves the continuing effort to evaluate hydrologic effects of converting pinyon-juniper woodland to open grassland.

OBJECTIVES:

Objectives of this study are (1) to determine the effects of grazing, when compared to areas on which grazing has been excluded, on selected hydrologic parameters of chained, debris-in-place; chained, debris-windrowed; and unchained pinyon-juniper sites and (2) utilize these measurements in developing guidelines for grazing management of pinyon-juniper rangeland that will protect and/or improve the hydrologic value of the watershed. Of particular interest are the following items:

1. Influence of grazing on infiltration and sediment production rates, especially as related to surface soil changes and vegetal modifications,
2. Changes in infiltration and sediment production rates as a function of time since grazing has been excluded,
3. Develop multiple regression models for predicting infiltration and erosion rates of chained and unchained pinyon-juniper rangeland subjected to various grazing situations.

The following treatments are being investigated:

A. Chained, debris-in-place.
   1. Grazing not excluded
   2. Grazing excluded 1967
   3. Grazing excluded 1969
   4. Grazing excluded 1971

B. Chained, debris-windrowed
   5. Grazing not excluded
   6. Grazing excluded 1967
   7. Grazing excluded 1971

C. Not chained
   8. Grazing not excluded
   9. Grazing excluded 1967
   10. Grazing excluded 1969
   11. Grazing excluded 1971

RESEARCH PLANS:

Initial hypothesis of this study is that grazing of chained and unchained pinyon-juniper rangeland will affect hydrologic, vegetative, and

edaphic parameters of the sites and these effects will vary with the length of time grazing has been excluded and with the particular treatment imposed. Expected effects attributable to grazing are removal of above ground plant material; and therefore, decreased soil protection; compaction of the soil surface by trampling; altered infiltration capacities; and accelerated erosion. Elimination of grazing is expected to eliminate or reverse these hydrologically detrimental effects. The presently unknown time sequence of recovery is also being investigated.

Study area. Previously chained and seeded sites near Blanding, Utah were chosen for study. The area is approximately in the center of the pinyon-juniper distribution range and the availability of closely adjacent chained, debris-in-place; chained, debris-windrowed; and unchained sites with grazing exclosures previously established for one, two, and four years made this a highly desirable study area.

The areas surrounding the grazing exclosures are grazed from May 1 to June 15 and October 1 to November 1 each year with cattle. Management of the herd does not allow estimation of the grazing intensity.

Basic research procedure. Runoff and erosion was artifically induced from small plots by simulating high intensity (3 in/hr or greater) rainfall with the Rocky Mountain Infiltrometer (Dortignac 1951). The infiltration rate (rainfall applied-runoff), sediment production, and selected vegetation and edaphic parameters were measured from each plot sampled. Data were collected immediately after the spring grazing period and after two months of rest from grazing pressure during 1971. Approximately 231 infiltrometer plots were sampled during each period. Field procedures were similar to those described by Williams (1969).

One-third of the plots (not grazing exclosures) were clipped to simulate grazing occurring on adjacent grazed areas. Another one-third of the ungrazed plots were completely denuded to approximate the bare soil condition encountered in the unchained areas. These plots provide information on hydrologic effects associated with forage removal but with trampling eliminated. The remaining plots received no pre-infiltration test clipping treatment. Vegetation and soil surface cover characteristics were determined for all plots after these clipping treatments were imposed.

Following the infiltration and erosion measurements, vegetative material present within each infiltrometer plot was clipped at ground level, oven dried, and weights converted to pound/acre of forage.

One- and 3-inch deep (3 inches diameter) soil cores were collected from within the plots and hydraulic conductivity, bulk density, and porosity determined for each core (Hoover, Olson, and Metz 1954). These parameters were determined for each sampling period. In addition, following the second sampling period soil texture and percent water stable aggregates were determined for the two soil cores (Bouyoucos 1929 and 1962).

Stepwise multiple regression modeling techniques will be utilized to explain variation in infiltration and erosion rates (dependent or 'y' variables) using the hydrologic, edaphic, and vegetative parameters as independent or 'x' variables.

RESEARCH ACCOMPLISHMENTS:

All information described above was collected during the 1971 sampling periods; however, data analysis is not complete.

Maximum infiltration rates for each treatment and sampling period are indicated in Figures 1 to 6. In general, infiltration rates were lowest on grazed plots, with increasing rates exhibited as the period of protection from grazing increased. Grazed plots recorded lower water intake rates than the plots receiving the pre-run clipping treatment. Therefore, reduced infiltration rates found on grazed areas may not be attributable to forage removal, but rather to soil compaction by the animal.

The June-July sampling period (Figures 1, 2, 3) exhibited a higher minimum infiltration rate than the August-September period (Figures 4, 5, 6). This difference is probably due to a seasonal change in infiltration capacity. This late season reduction in water intake rates is of considerable practical importance because high intensity thunderstorms commonly occur during this period.

FUTURE RESEARCH PLANS:

An artifical trampling treatment will be included in the study during the June, 1972, sampling period. This treatment will consist of subjecting randomally selected points (covering approximately one half of the plot area) to a compacting force of 24 pounds per square inch. This force is the static load pressure calculated for cattle by Lull (1959). This compaction technique will be applied to one-third of the ungrazed plots which have also been clipped to a simulated grazing intensity. This treatment should approximate conditions occurring on grazed plots. Another one-third of the ungrazed plots will be compacted but not clipped. These plots should provide data on hydrologic effects associated with trampling but with forage removal eliminated. The remaining plots will not be disturbed prior to the infiltration test.

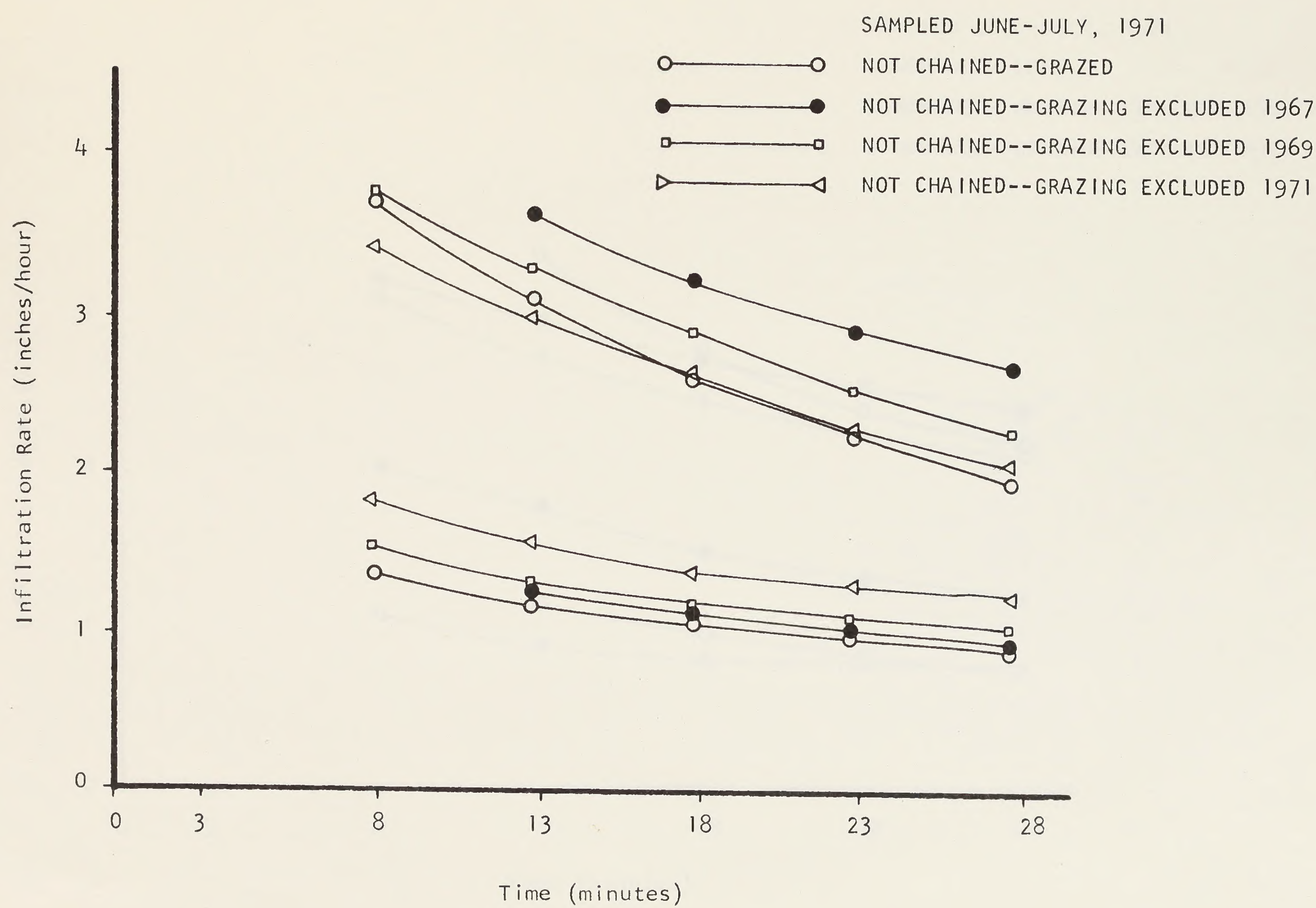

Figure 1. Maximum and minimum infiltration rates.

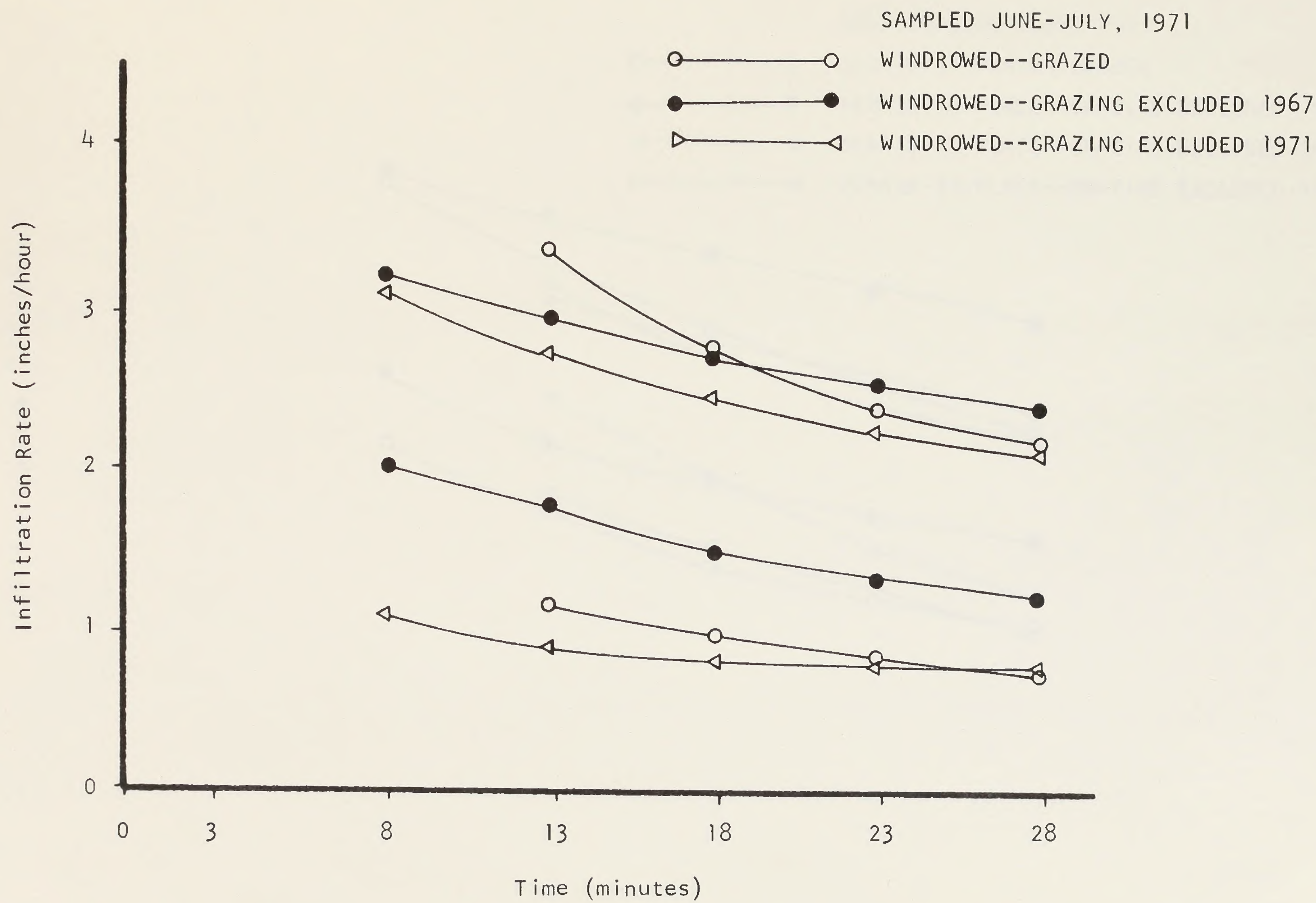

Figure 2. Maximum and minimum infiltration rates (plots not clipped before run).

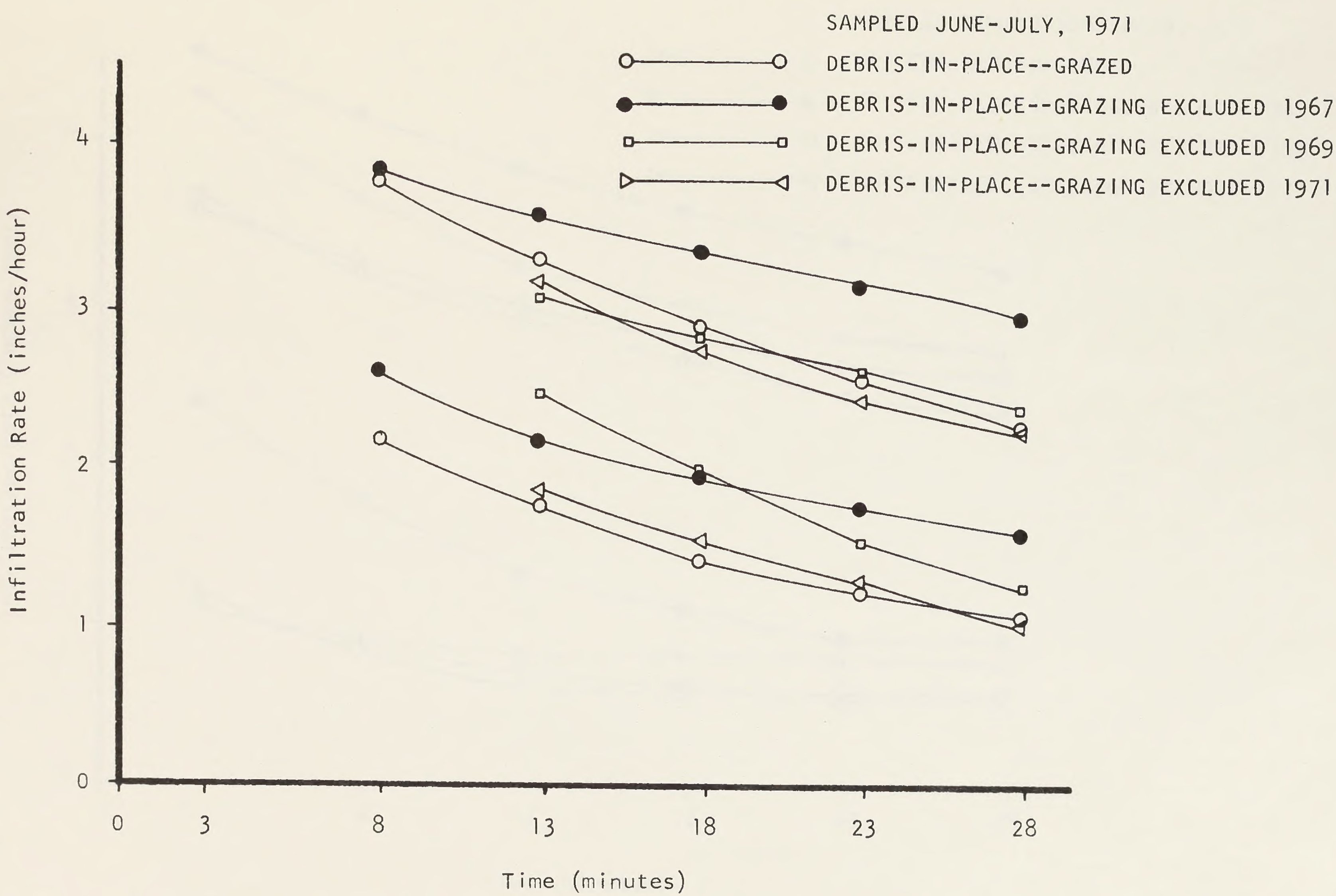

Figure 3. Maximum and minimum infiltration rates (plots not clipped before run).

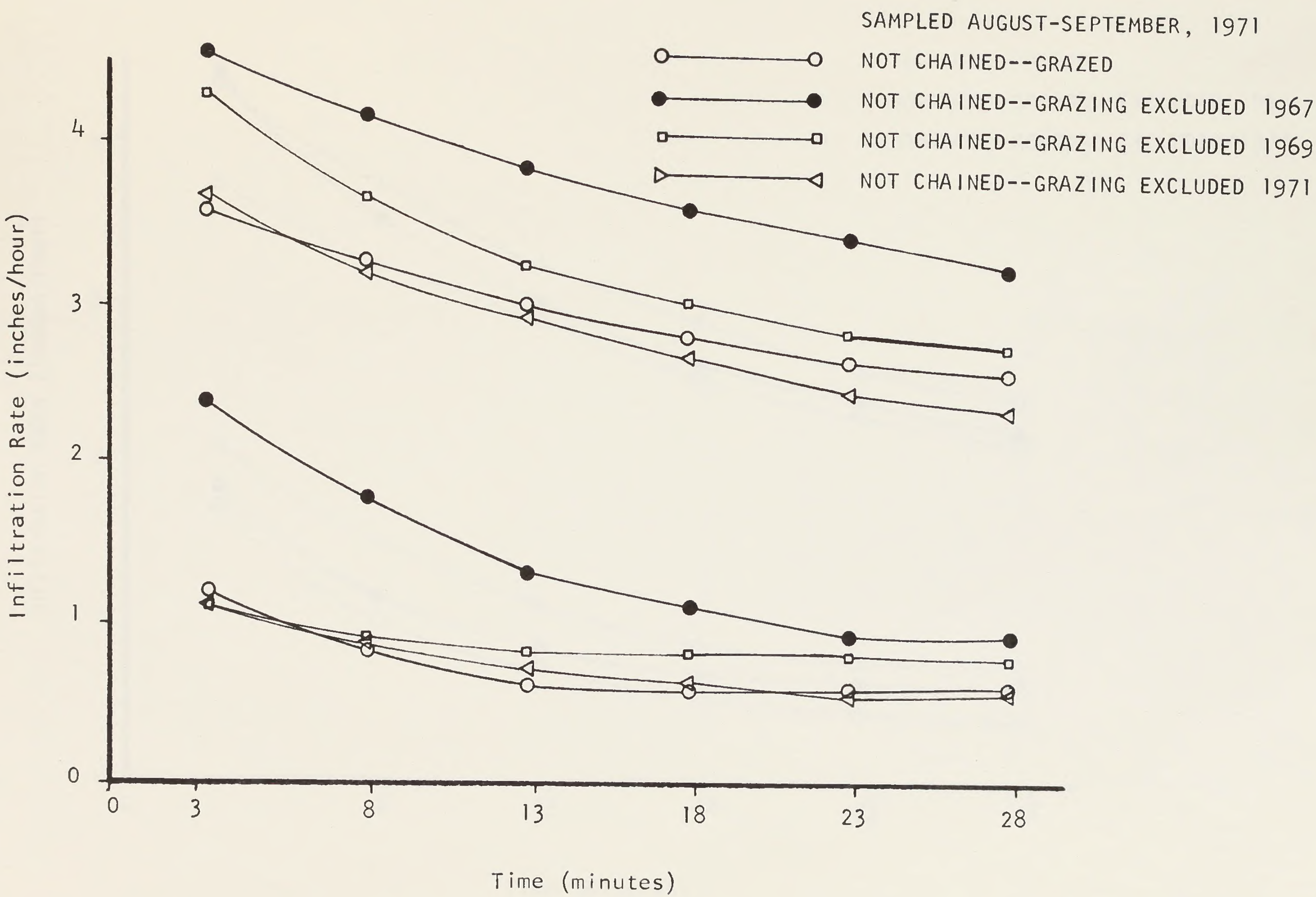

Figure 4. Maximum and minimum infiltration rates.

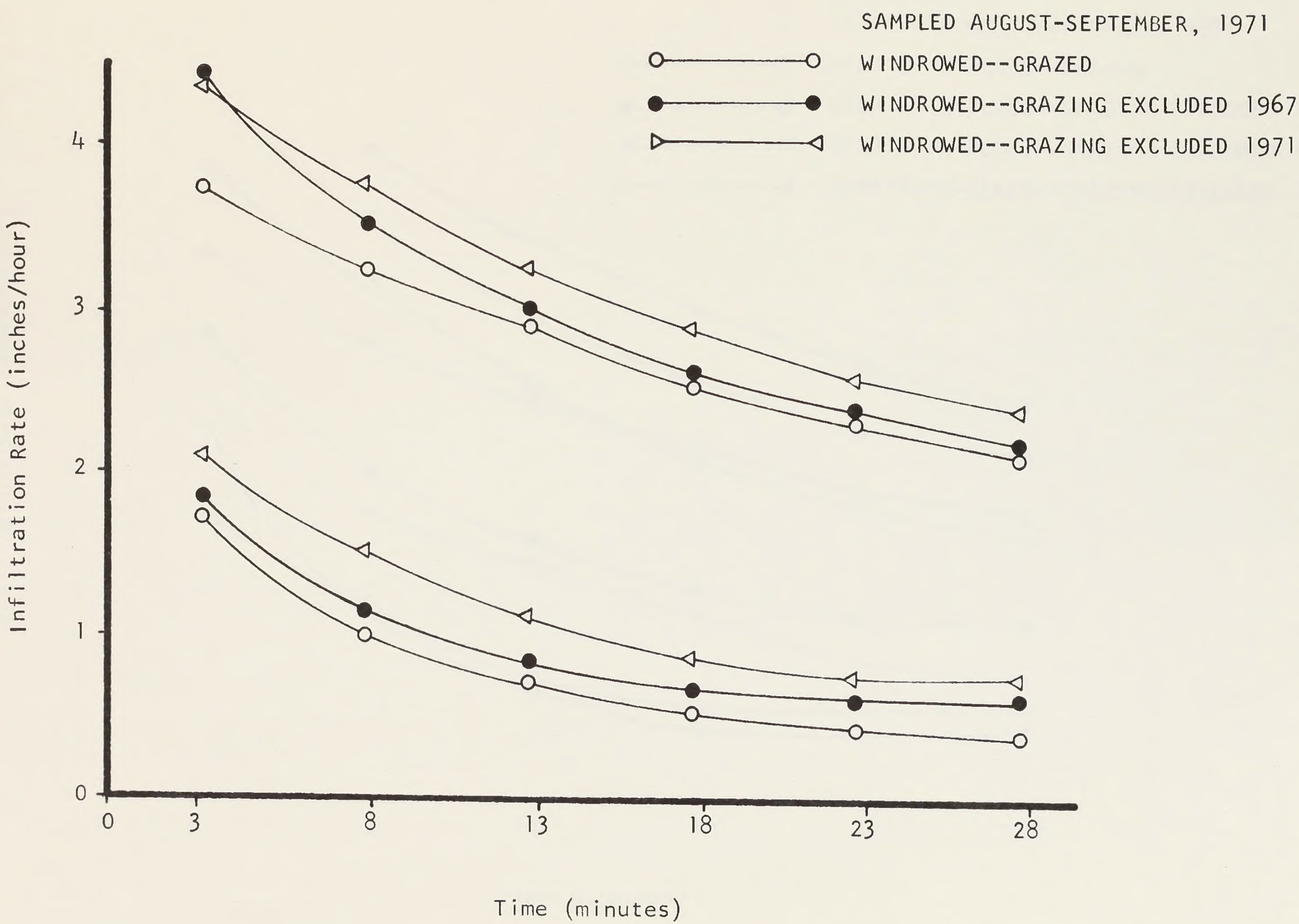

Figure 5. Maximum and minimum infiltration rates (plots not clipped before run).

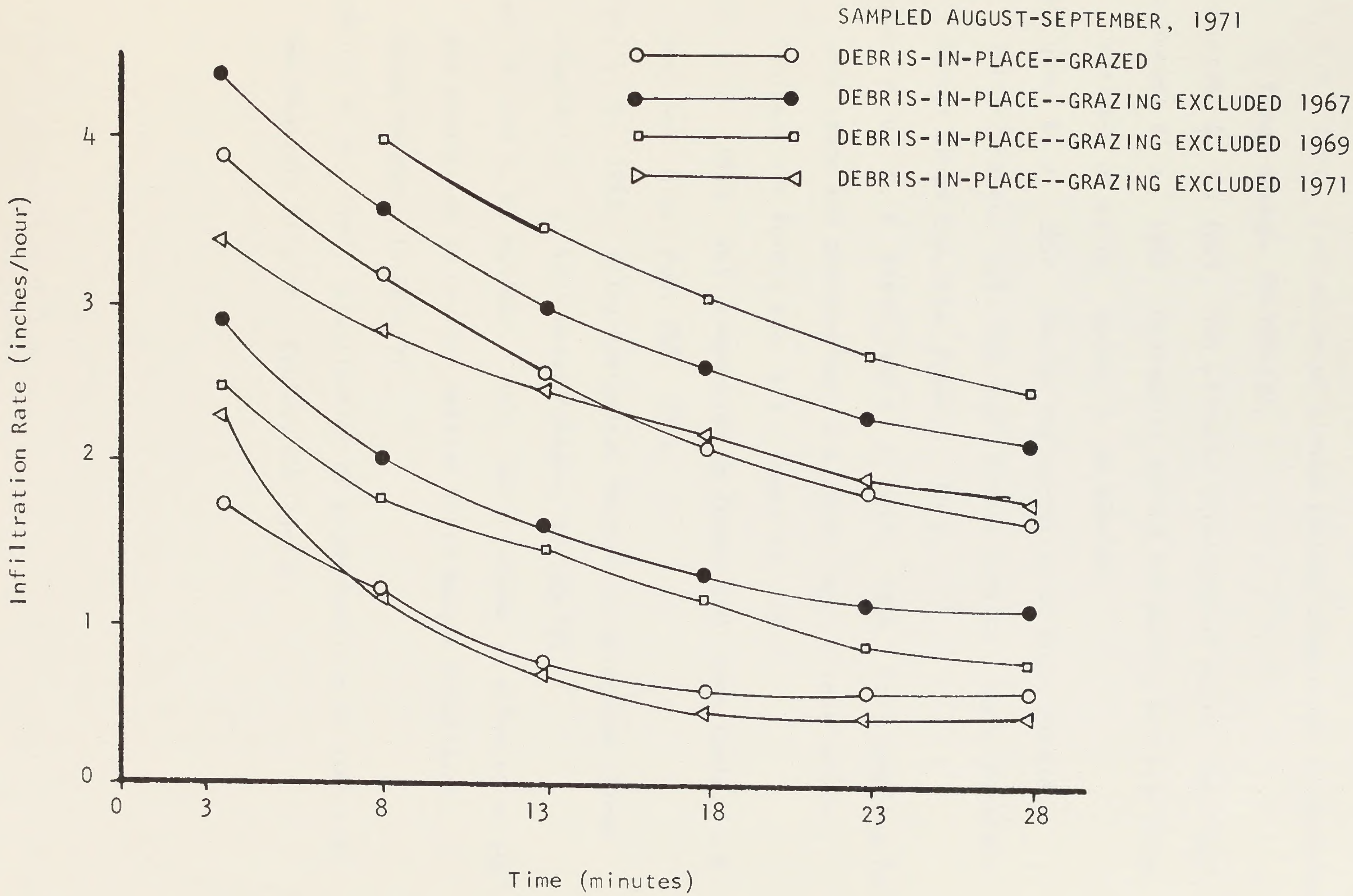

Figure 6. Maximum and minimum infiltration rates (plots not clipped before run).

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Rauzi, F. and A. R. Kuhlman. 1961. Water intake as affected by soil and vegetation on certain western South Dakota rangelands. J. Range Manage. 14:267-271.

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Soil Moisture Studies:

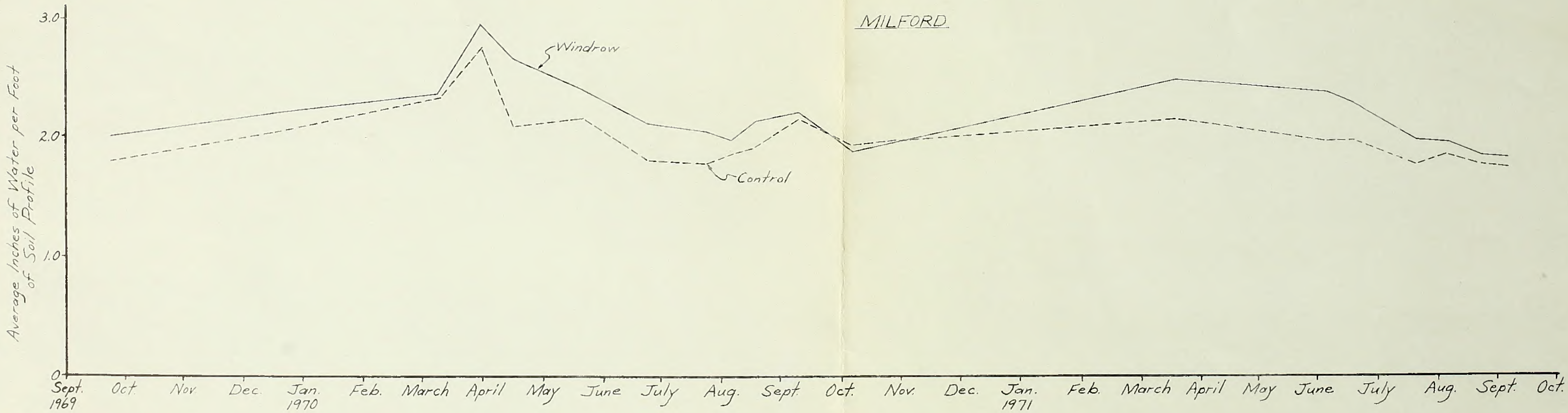
Milford. Soil moisture data are now available for two years from the Milford site. Figures 7 (windrow vs. control) and 8 (debris-left-in-place vs. control) represent average inches of water per foot of soil profile on various sampling dates. The windrowed treatment had consistantly greater soil moisture values per foot of soil profile than did respective controls. The differences in water per foot of soil profile between the debris-in-place treatment and respective controls were uniformily greater than the windrowed treatment and its respective control.

Regardless of treatment, the greatest differences in water per foot of soil profile occurred during March through April. The greatest accumulation of soil moisture was in early spring.

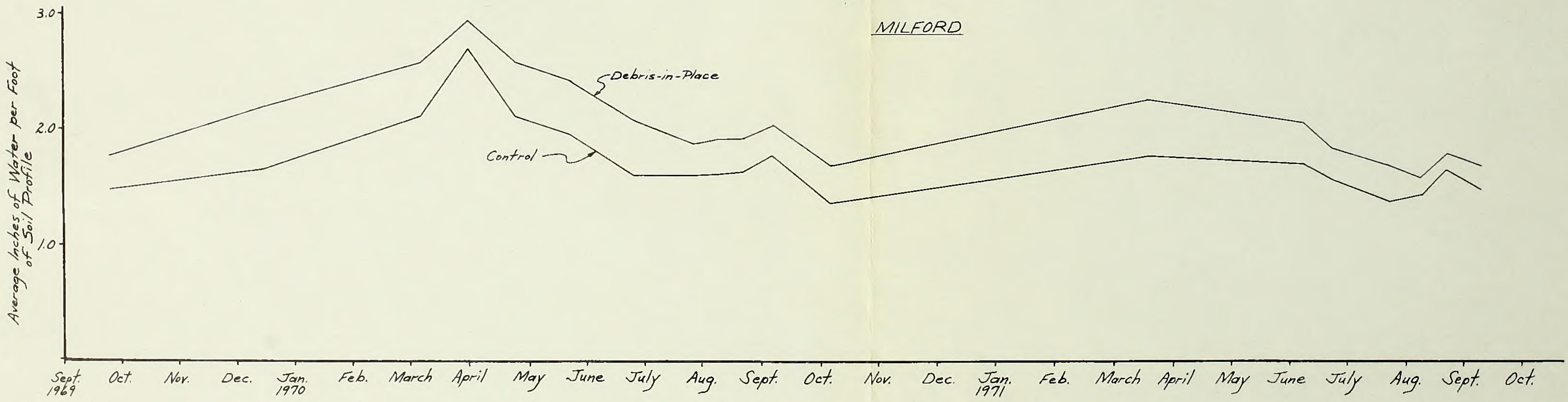
Figures 9 (windrow vs. control) and 10 (debris-in-place vs. control) represent average inches of water per foot of soil profile averaged over two years. The average amount of water is least in the first foot of soil profile. Average soil moisture at the 2-, 3-, and 4-foot depths is relatively uniform. The greatest difference in soil moisture between the chaining treatments and their controls is in the last two feet of soil profile.

Blanding. Soil moisture data are available for one year from the Blanding site. Figure 11 represents average inches of water per foot of soil profile for the three treatments on various sampling dates. The debris-in-place treatment had the most water per foot of soil profile over the whole year. There is a slight peak in April, which probably indicates the time of maximum accumulation of soil moisture.

Figure 12 represents average inches of water per foot of soil profile for each treatment, averaged over one year. As at Milford, the least average amount of soil moisture is in the first foot of soil profile. From 2 to 5



MILFORD
Windrow
Control
Average Inches of Water per Foot of Soil Profile
3.0
2.0
1.0
0
Sept. 1969
Oct.
Nov.
Dec.
Jan. 1970
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan. 1971
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.


MILFORD
Debris-in-Place
Control
Average Inches of Water per Foot of Soil Profile
3.0
2.0
1.0
Sept. 1969
Oct.
Nov.
Dec.
Jan. 1970
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan. 1971
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.

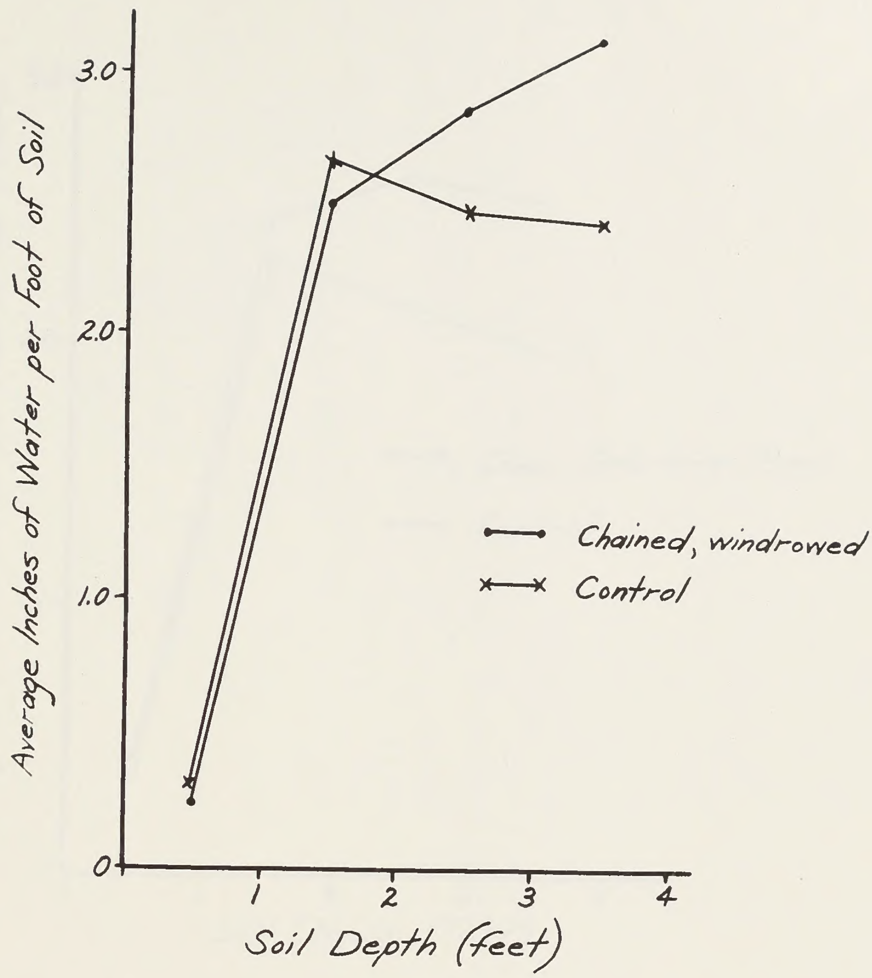


Figure 9. Inches of water per foot of soil profile for the windrow treatment at Milford.

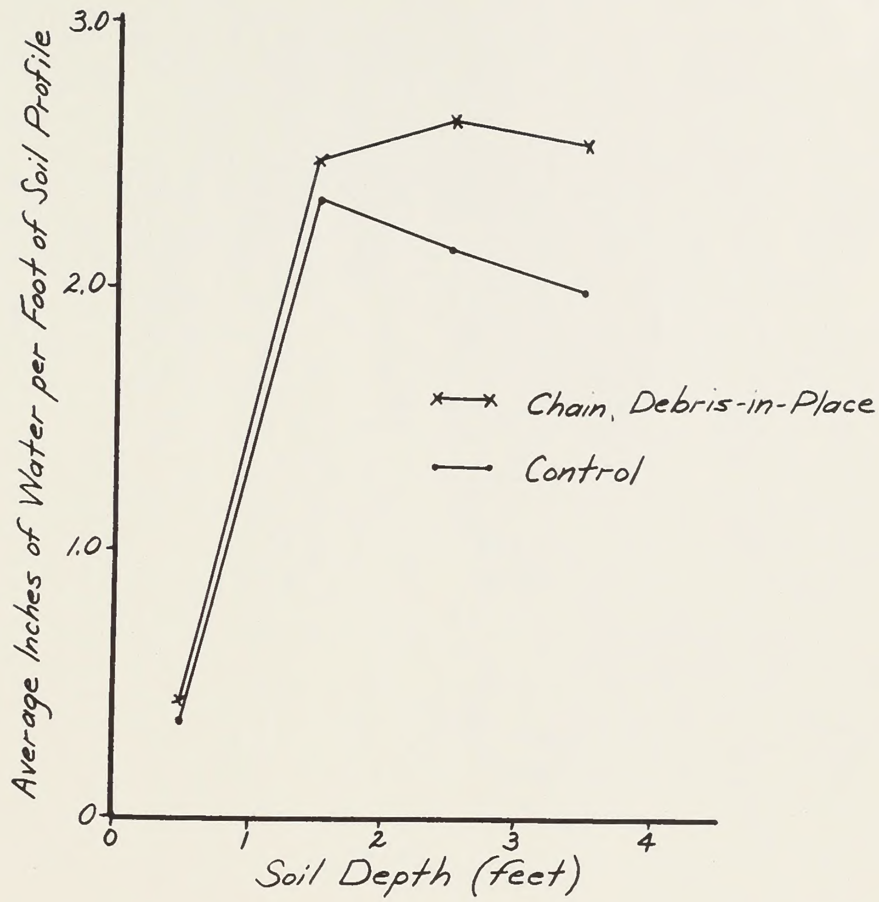
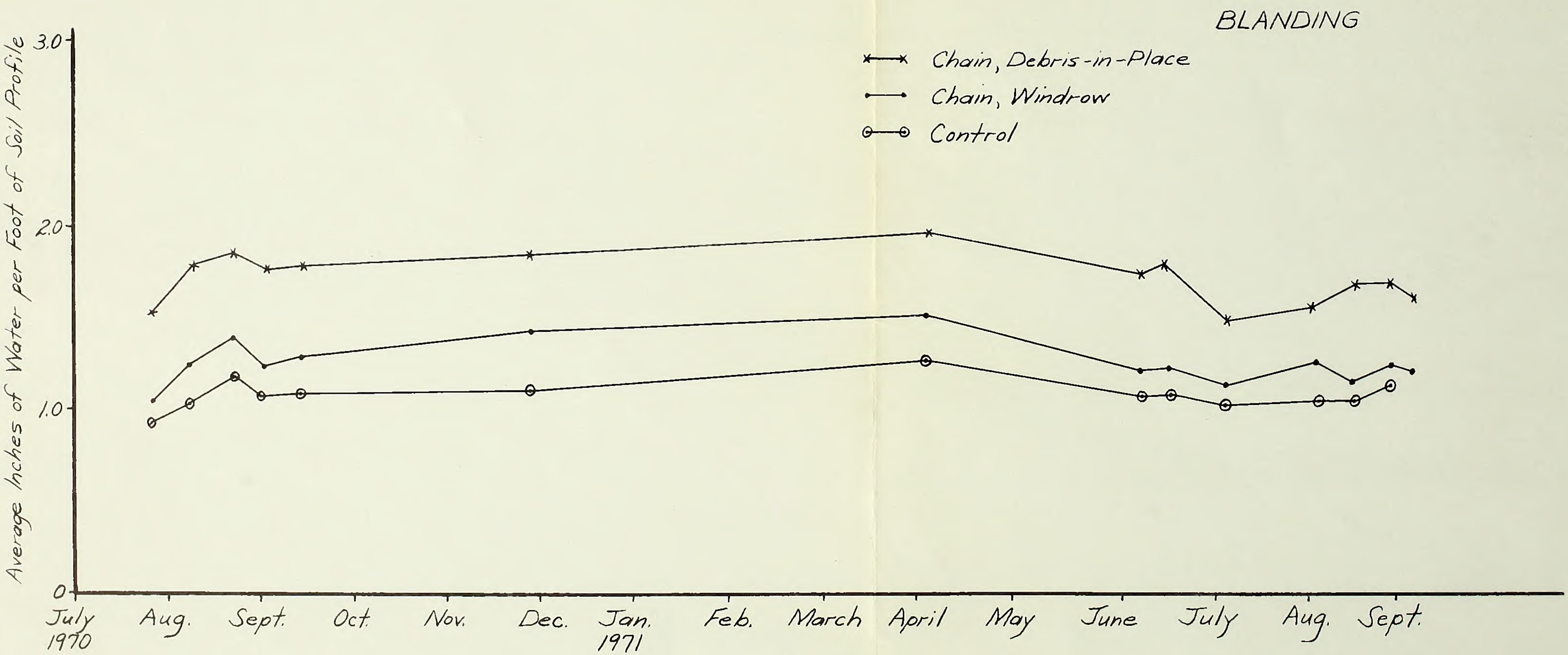


Figure 10. Inches of water per foot of soil profile for the debris-in-place treatment at Milford.


BLANDING
Chain, Debris-in-Place
Chain, Windrow
Control
Average Inches of Water per Foot of Soil Profile
3.0
2.0
1.0
0
July 1970
Aug.
Sept.
Oct.
Nov.
Dec.
Jan. 1971
Feb.
March
April
May
June
July
Aug.
Sept.

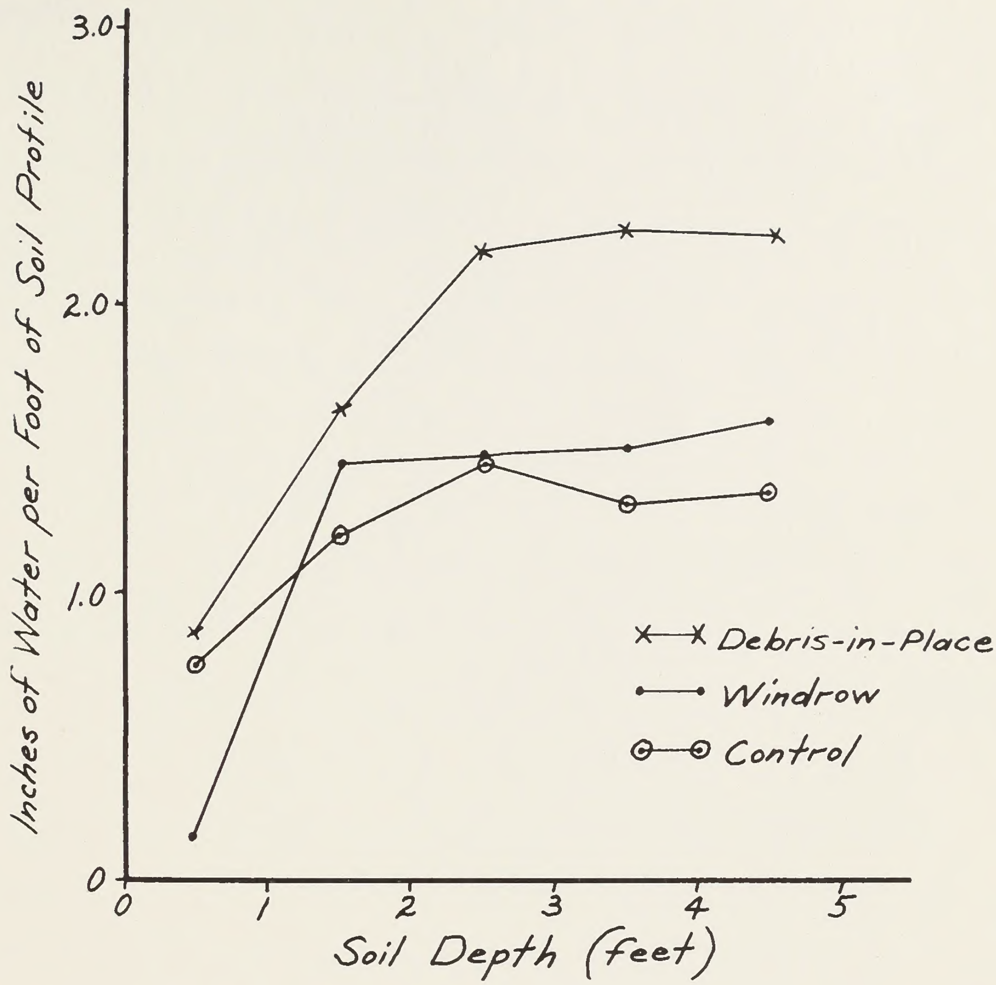


Figure 12. Inches of water per foot of soil profile for the three treatments at Blanding.

feet the soil moisture is relatively uniform. The greatest difference in soil moisture among the different treatments is in the last three feet of soil profile.

Sap Velocity Studies

A study on sap flow patterns of Utah juniper (Juniperus osteosperma) and pinyon pine (Pinus edulis) was done near Blanding, Utah, over a two year period. The object of the study was to compare sap velocities of the two species. Soil moisture and other environmental factors (wind, temperature, relative humidity and incoming short wave radiation) were taken during the study. Sap flow was taken three to four days per month during the summer and one day or less per month during the rest of the year.

The data were statistically analyzed and results indicated that soil moisture availability was the major factor in controlling which species had the highest sap velocities. During 1970, the Blanding area had an above average year in precipitation. Pinyon pine trees had a significantly higher sap velocity than the Utah juniper trees from August until the end of November. From December 1970 until September 1971, the precipitation was way below normal for the same area. There was no significant difference in sap velocities between the two species of trees from December until May. When the water deficit was the greatest from June to July, Utah juniper trees had a significantly higher sap velocity than the pinyon pine trees.

It is concluded that when soil moisture is readily available the pinyon pine trees has the significantly highest sap velocity of the two species. Utah juniper trees have significantly higher sap velocities than pinyon pine trees when soil moisture is not readily available. A possible explanation for the different responses of the two species is the different physiological characteristics of the leaves and different rooting characteristics.

Sap velocity was not strongly related to green biomass of either tree species. Figure 13 relates green biomass (both species) to diameter at the one foot height (r = .954) and Figure 14 shows the relation of sap velocity (for both species) to tree diameter at the one foot level. This indicates that sap velocities are apparently independent of tree diameter and green biomass, meaning that total water use is a function of conducting area of the tree stem, as well as sap velocity.

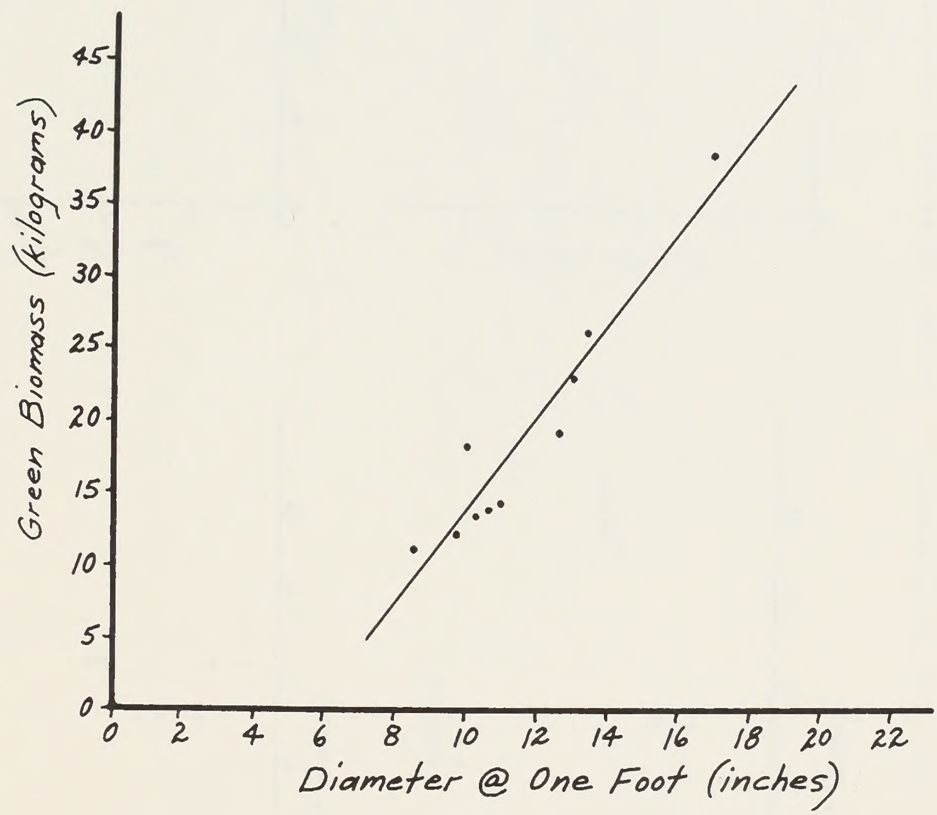


Figure 13. Relationship of green biomass to diameter of pinyon and juniper trees at one foot height. Trees were taken from both the Blanding and Milford study sites.

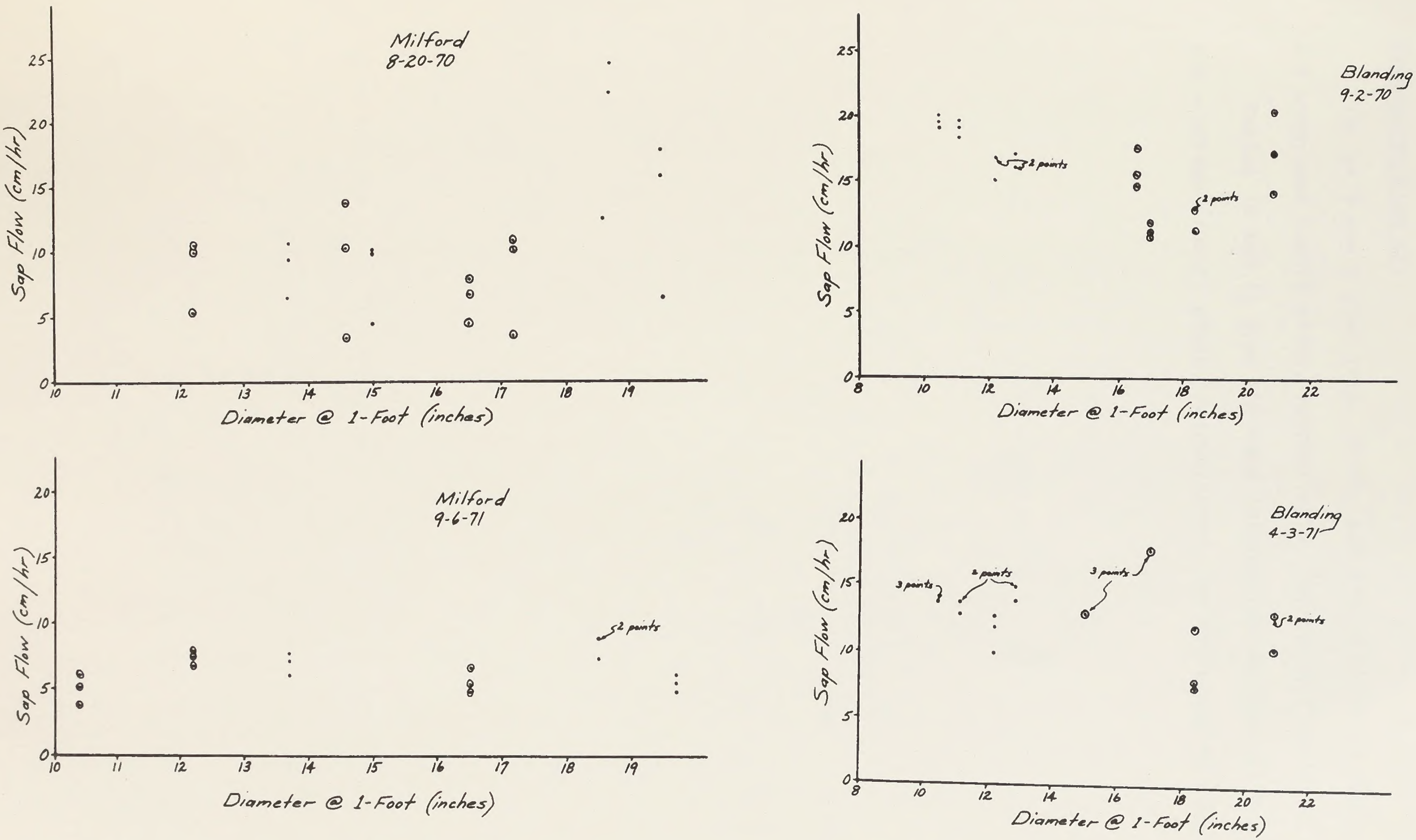


Figure 14. Relationship of sap flow to diameter of pinyon (circles) and juniper (dots) trees at one foot height at Milford and Blanding on two select dates. Points represent three one-hour sap velocity readings on three to four trees of each species during time when maximum flow rates were measured, usually mid-day.

Vegetation Studies:

Tables 8 and 9 give tree, shrub, and ground cover on debris-in-place and windrowed runoff plots, respectively, for the Milford site, 1971.

Tables 10 and 11 give the same information for debris-in-place and windrowed runoff plots, respectively, for the Blanding site, 1971.

TABLE 8. Tree, shrub, and ground cover (percent) on debris-in-place runoff plots at Milford study site, September, 1971.

Plot	Transect Number 1/	Percent Cover: Trees	Shrub	Ground 2/
Debris-in-place #1	19 ft	0	Artr 9 Chvi 2	BG 2 L 30 Agcr 6 EP 58 Misc 1 Sphaeralcea spp 3
	33 ft	0	Artr 4 Chvi 10	BG 0 L 22 Agcr 8 EP 68 Chvi 10 Sphaeralcea spp 2
	55 ft	0	Artr 11 Chvi 1	BG 0 L 34 Agcr 8 EP 57 Sphaeralcea spp 1
	74 ft	0	Artr 3 Chvi 2	BG 1 L 29 Agcr 8 EP 58 Sphaeralcea spp 4
	(Mean) $\bar{x}$	0	Artr 7 Chvi 4	BG 1 L 28 Agcr 8 EP 61 Sphaeralcea spp 2
Debris-in-place #2	19 ft	0	Artr 9 Chvi 11	BG 3 L 39 Agcr 1 EP 55 Phlox spp 2
	33 ft	0	Artr 3 Chvi 13	BG 3 L 38 Agcr 7 EP 48 Orhy 2 Phlox spp 1 Sphaeralcea spp 1

Table 8 (contd)

Plot	Transect Number 1/	Percent Cover Trees	Shrub	Ground 2/
	55 ft	0	Chvi 14	BG 2 L 37 Agcr 15 EP 41 Penstemon spp 2 Eriogonum spp 2 Sphaeralcea spp 1
	74 ft	0	Artr 7 Chvi 8	BG 2 L 36 Agcr 12 EP 49 Lupine spp 1
	(Mean) $\bar{x}$	0	Artr 5 Chvi 11	BG 3 L 38 Agcr 9 EP 48 Phlox spp 1 Lupine spp 1
Debris-in-place #3	19 ft	0	Artr 2 Chvi 2	BG 4 L 60 Agcr 17 EP 15 Lupine spp 3 Eriogonum spp 1
	33 ft	0	Artr 6 Chvi 2	BG 12 L 43 Agcr 27 EP 13 Eriogonum spp 1 Penstemon spp 4
	55 ft	0	Artr 5 Chvi 5	BG 3 L 31 Agcr 18 EP 46 Eriogonum spp 1 Sphaeralcea spp 1
	74 ft	Juos 5	Artr 1 Chvi 8	BG 8 L 39 Agcr 13 EP 37 Penstemon spp 1 Eriogonum spp 1 Sphaeralcea spp 1

Table 8 (contd)

Plot	Transect Number 1/	Percent Cover Trees	Shrub	Ground 2/
	(Mean) x̄	Juos 1	Artr 4 Chvi 4	BG 6 L 42 Agcr 19 EP 29 Eriogonum spp 1 Lupine spp 1 Sphaeralcea spp 1 Penstemon spp 1
Depris-in-place #4	19 ft	Juos 15	Artr 2 Chvi 10	BG 1 L 47 Agcr 18 EP 31 Phlox spp 2 Sphaeralcea spp 1
	33 ft	0	Artr 14 Chvi 7	BG 1 L 31 Agcr 18 EP 44 Phlox spp 1 Sphaeralcea spp 5
	55 ft	0	Artr 1 Chvi 1	BG 0 L 9 Agcr 15 EP 67 Orhy 1 Sphaeralcea spp 8
	74 ft	0	Artr 3	BG 0 L 10 Agcr 16 EP 64 Sphaeralcea spp 8 Eriogonum spp 1 Lupine spp 1
	(Mean) x̄	Juos 4	Artr 5 Chvi 4	BG 1 L 25 Agcr 18 EP 51 Phlox spp 1 Sphaeralcea spp 4

Table 8 (contd)

Plot	Transect Number 1/	Percent Cover Trees	Shrub	Ground 2/
Debris-in-place #5	19 ft	Pied 8	Artr 5	BG 0
			Chvi 10	L 34
				Agcr 12
				EP 54
	33 ft	Pied 4	Artr 18	BG 1
			Chvi 6	L 33
				Agcr 13
				EP 51
				Lupine spp 1
				Eriogonum spp 1
	55 ft	Pied 3	Artr 16	BG 0
			Chvi 10	L 20
				Agcr 6
				EP 73
				Sphaeralcea spp 1
	74 ft	Juos 1	Artr 4	BG 0
			Chvi 14	L 20
				Agcr 8
				EP 71
				Eriogonum spp 1
	(Mean) x̄	Pied 4	Artr 11	BG 0
			Chvi 10	L 27
				Agcr 10
				EP 62
				Misc 1

1/ Line transects across runoff plots at indicated distances measured from top of plot.

2/ BG = Bare ground
L = Litter
Agcr = *Agropyron cristatum*
EP = Erosion Pavement
Pied = *Pinus edulis*
Juos = *Juniperus osteosperma*
Chvi = *Chrysothamnus viscidiflorus*
Orhy = *Oryzopsis hymenoides*

Table 9. Tree, shrub, and ground cover (percent) on windrowed runoff plots at the MIlford study site, September, 1971.

Plot	Transect Number 1/	Percent Cover Trees	Shrub	Ground 2/	
Windrow #1	19 ft.	0	0	BG	0
				L	4
				Agcr	30
				EP	64
				Rock	1
				Penstemon	1
	33 ft.	0	Artr 2	BG	3
				L	6
				Agcr	26
				EP	60
				Rock	4
				Misc.	1
	55 ft.	0	0	BG	0
				L	4
				Agcr	29
				EP	64
				Rock	3
	74 ft.	0	Artr 1	BG	6
				L	10
				Agcr	29
				EP	53
				Rock	2
(Mean)	$\bar{x}$	0	Artr 1	BG	2
				L	6
				Agcr	29
				EP	60
				Rock	2
				Penstemon	1
Windrow #2	19 ft.	0	0	BG	70
				L	4
				Agcr	24
				Lupine	2
	33 ft.	0	0	BG	61
				L	16
				Agcr	23
	55 ft.	0	0	BG	65
				L	9
				Agcr	26
	74 ft.	0	0	BG	57
				L	12
				Agcr	30
				Misc.	1
(Mean)	$\bar{x}$	0	0	BG	63
				L	10
				Agcr	26
				Lupine	1

Table 9. Continued.

Plot	Transect Number[1]	Percent Cover Trees	Shrubs	Ground[2]	
Windrow #3	19 ft.	0	0	BG	3
				L	2
				Agcr	23
				EP	70
				Penstemon	1
				Misc.	1
	33 ft.	0	0	BG	1
				L	8
				Agcr	21
				EP	69
				Rock	1
	55 ft.	0	0	BG	4
				L	7
				Agcr	23
				EP	65
				Rock	1
	74 ft.	0	0	BG	18
				L	18
				Agcr	23
				EP	36
				Penstemon	5
(Mean)	$\bar{x}$	0	0	BG	7
				L	9
				Agcr	22
				EP	60
				Rock	1
				Penstemon	1
Windrow #4	19 ft.	0	0	BG	20
				L	1
				Agcr	25
				EP	44
				Lupine	9
				Penstemon	1
	33 ft.	0	0	BG	36
				L	10
				Agcr	21
				EP	31
				Lupine	1
				Penstemon	1
	55 ft.	0	Artr 1	BG	32
				L	3
				Agcr	24
				EP	31
				Lupine	10
	74 ft.	0	Artr 1	BG	57
				L	12
				Agcr	23
				EP	0
				Lupine	8

Table 9. Continued.

Plot	Transect Number[1]	Percent Cover Trees	Shrubs	Ground[2]	
	(mean) $\bar{x}$	0	Artr 1	BG	37
				L	6
				Agcr	23
				EP	26
				Lupine	7
				Penstemon	1
Windrow #5	19 ft.	0	0	BG	66
				L	1
				Agcr	31
				Lupine	2
	33 ft.	0	0	BG	71
				L	2
				Agcr	27
	55 ft.	0	0	BG	55
				L	14
				Agcr	30
				Rock	1
	74 ft.	0	0	BG	70
				L	5
				Agcr	22
				Rock	3
	(Mean $\bar{x}$	0	0	BG	65
				L	6
				Agcr	27
				Lupine	1
				Rock	1

[1]Line transects across runoff plots at indicated distances measured from top of plot.

[2]BG = Bare Ground
L = Litter
Agcr = *Agropyron cristatum*
EP = Erosion Pavement

TABLE 10, Tree, shrub, and ground cover (percent) on debris-in-place runoff plots at Blanding study site, September, 1971.

Plot	Transect Number 1/	Percent Cover		
		Trees	Shrub	Ground 2/
Debris-in-place #1	19 ft	Juos 18	0	BG 10 L 83 Agcr 6 Saka 1
	33 ft	0	0	BG 32 L 35 Agcr 27 Saka 5 Aster spp 1
	55 ft	0	0	BG 33 L 47 Agcr 20
	74 ft	Juos 22	0	BG 51 L 40 Agcr 7 Saka 1 Aster spp 1
	(Mean) $\bar{x}$	Juos 10	0	BG 32 L 51 Agcr 15 Aster spp 1 Saka 1
Debris-in-place #2	19 ft	Juos 4	0	BG 54 L 19 Agcr 27
	33 ft	0	0	BG 42 L 50 Agcr 8
	55 ft	0	0	BG 36 L 51 Agcr 13
	74 ft	Juos 9	0	BG 34 L 50 Agcr 12 Saka 4

Table 10 (contd)

Plot	Transect Number 1/	Percent Cover Trees	Shrub	Ground 2/
	(Mean) x̄	Juos 3	0	BG 41 L 42 Agcr 16 Saka 1
Debris-in-place #3	19 ft	0	0	BG 44 L 32 Agcr 24
				A
	33 ft	Juos 6	0	BG 14 L 74 Agcr 12
	55 ft	0	0	BG 30 L 53 Agcr 17
	74 ft	Juos 17	0	BG 45 L 33 Agcr 22 Sphaeralcea spp 2
	(Mean) x̄	Juos 6	0	BG 33 L 48 Agcr 19
Debris-in-place #4	19 ft	0	0	BG 42 L 43 Agcr 13 Saka 2
	33 ft	0	0	BG 30 L 34 Agcr 30 Saka 2 Sphaeralcea spp 2
	55 ft	0	0	BG 52 L 27 Saka 2 Agcr 18 Sphaeralcea spp 1
	74 ft	0	0	BG 4 L 88 Agcr 5 Sphaeralcea spp 3

Table 10 (contd)

Plot	Transect	Percent Cover		
		Trees	Shrub	Ground 2/
	(Mean) $\bar{x}$	0	0	BG 32
				L 48
				Agcr 16
				Saka 2
				Sphaeralcea spp 2
Debris-in-place #5	19 ft	0	0	BG 51
				L 36
				Agcr 13
	33 ft	0	0	BG 40
				L 44
				Agcr 16
	55 ft	Juos 6	0	BG 29
				L 50
				Agcr 5
				Aster spp 2
				Saka 6
				Opuntia spp 2
				Sphaeralcea spp 6
	74 ft	0	0	BG 61
				L 22
				Agcr 17
	(Mean) $\bar{x}$	Juos 1	0	BG 45
				L 40
				Agcr 13
				Saka 1
				Sphaeralcea spp 1

1/ Line transects across runoff plots at indicated distances measured from top of plot.

2/ BG = Bare ground
L = Litter
Agcr = *Agropyron cristatum*
Saka = *Salsola kali*
Juos = *Juniperus osteosperma*

TABLE 11. Tree, shrub, and ground cover (percent) on windrowed runoff plots at the Blanding study site, September, 1971.

Plot	Transect Number 1/	Percent Cover		
		Trees	Shrub	Ground
Windrow #1	19 ft	0	0	BG 58 L 16 Agcr 26
	33 ft	0	0	BG 56 L 14 Agcr 30
	55 ft	0	0	BG 46 L 29 Agcr 25
	74 ft	0	Artr 3	BG 65 L 15 Agcr 20
	(Mean) $\bar{x}$	0	Artr 1	BG 56 L 19 Agcr 25
Windrow #2	19 ft	0	0	BG 52 L 15 Agcr 32 Circium spp 1
	33 ft	0	0	BG 66 L 15 Agcr 18 Sphaeralcea spp 1
	55 ft	0	0	BG 71 L 4 Agcr 25
	74 ft	0	0	BG 68 L 11 Agcr 18 Sphaeralcea spp 3
	(Mean) $\bar{x}$	0	0	BG 64 L 12 Agcr 23 Sphaeralcea spp 1

Table 11, (contd)

Plot	Transect Number 1/	Percent Cover		
		Trees	Shrub	Ground
Windrow #3	19 ft	0	Artr 2	BG 57 L 27 Agcr 16
	33 ft	0	0	BG 49 L 32 Agcr 19
	55 ft	0	0	BG 45 L 39 Agcr 16
	74 ft	0	0	BG 40 L 47 Agcr 13
	(Mean) $\bar{x}$	0	0	BG 48 L 36 Agcr 16
Windrow #4	19 ft	0	0	BG 54 L 25 Agcr 21
	33 ft	0	0	BG 62 L 21 Agcr 17
	55 ft	0	0	BG 58 L 27 Agcr 15
	74 ft	0	0	BG 44 L 36 Agcr 20
	(Mean) $\bar{x}$	0	0	BG 54 L 28 Agcr 18
Windrow #5	19 ft	0	0	BG 42 L 32 Agcr 26
	33 ft	0	0	BG 65 L 14 Agcr 21

Table 11. (contd)

Plot	Transect Number 1/	Percent Cover		
		Trees	Shrub	Ground
	55 ft	0	0	BG 76 L 5 Agcr 18 Sphaeraclea spp 1
	74 ft	0	0	BG 69 L 5 Agcr 26
	(Mean) $\bar{x}$	0	0	BG 63 L 14 Agcr 23

1/ Line transects across runoff plots at indicated distances measured from top of plot.

2/ BG = Bare Ground
L = Litter
Agcr = Agropyron cristatum
EP = Erosion Pavement
Saka = Salsola Kali

APPENDIX #1

Soils data for each 0.11-acre plot

at Milford and Blanding

Soil Analysis Data

Milford

Runoff Plot: Windrow #1

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface [1/]	25	10 YR 3/2	10 YR 3/1	16	82	2	7.9
6" [2/]	10	10 YR 4/3	10 YR 3/4	52	38	10	7.7
12"	4	10 YR 7/1	10 YR 4/3	78	14	8	7.7
18"	13	10 YR 6/2	7.5 YR 4/4	78	16	6	8
24"	40	10 YR 7/2	10 YR 3/4	76	16	8	7.9
30"	37	10 YR 6/2	7.5 YR 3/2	76	16	8	8.1

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow #2

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	20	10 YR 4/2	10 YR 3/2	60	34	6	8.3
6" 2/	11	10YR 4/2	10 YR 3/2	76	16	8	7.8
12"	13	10 YR 5/2	10 YR 3/3	58	24	18	7.9
18"	2	10 YR 4/3	7.5 YR 3/2	48	28	24	7.4
24"	8	5 YR 5/3	5 YR 3/3	54	28	18	8.1
30"	6	10 YR 5/3	10 YR 3/3	46	36	18	8

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow #3

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface [1/]	38	10 YR 5/3	10 YR 3/2	64	24	12	8
6" [2/]	23	10 YR 4/2	10 YR 3/4	54	34	12	8
12"	25	7.5 YR 5/3	7.5 YR 3/4	52	24	24	7.8
18"	30	10 YR 5/4	10 YR 4/4	52	26	22	8
24"	40	10 YR 4/3	10 YR 4/4	54	42	4	8.1
30"	35	7.5 YR 3/2	10 YR 3/3	46	38	16	8.2

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow #4

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	8	10 YR 4/1	10 YR 3/1	84	12	4	8.1
6" 2/	15	10 YR 5/3	10 YR 4/4	36	52	12	8.2
12"	7	10 YR 6/1	10 YR 4/4	88	8	4	8.3
18"	7	10 YR 7/1	10 YR 6/4	92	8	0	8.3
24"	14	7.5 YR N/7	10 YR 3/1	98	2	0	8
30"	6	10 YR 8/1	10 YR 8/3	84	12	4	8.1

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow #5

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	20	10 YR 4/2	10 YR 3/2	28	64	8	8.1
6" 2/	21	7.5 YR 6/2	10 YR 4/3	28	62	10	8.2
12"	23	10 YR 8/1	10 YR 6/2	24	68	8	7.8
18"	29	7.5 YR 7/2	7.5 YR 5/2	14	78	8	8.4
24"	46	10 YR 8/1	10 YR 6/2	16	82	2	8.1
20"	73	10 YR 6/1	10 YR 4/2	92	6	2	8.3

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow Check #1

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	15	10 YR 5/2	10 YR 3/2	64	30	6	7.7
6" 2/	9	7.5 YR 4/2	7.5 YR 3/2	64	26	10	7.9
12"	12	10 YR 4/2	10 YR 3/2	74	20	6	8.3
18"	14	10 YR 6/1	10 YR 3/2	66	22	12	8.2
24"	15	10 YR 5/2	10 YR 3/3	76	14	10	8.2
30"	14	10 YR 5/4	10 YR 4/3	60	20	20	8.1

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow Check #2

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	29	10 YR 4/2	10 YR 3/1	60	34	6	8
6" 2/	37	10 YR 3/2	10 YR 3/4	68	16	16	7.8
12"	33	7.5 YR 5/4	5 YR 3/4	72	14	14	7.9
18"	33	5 YR 5/4	5 YR 3/3	34	46	20	7.7
24"	44	10 YR 6/2	7.5 YR 3/2	54	28	18	8.2
30"	59	10 YR 6/1	7.5 YR 3/5	82	12	6	8.2

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow Check #3

Depth of Sample	Percent Rock > 2 mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface 1/	17	10 YR 5/3	10 YR 3/2	72	20	8	8.3
6" 2/	8	5 YR 5/1	5 YR 3/2	80	12	8	8.1
12"	11	10 YR 5/2	10 YR 3/2	68	18	14	8.2
18"	13	10 YR 4/2	10 YR 3/2	26	64	10	8.3
24"	4	10 YR 5/2	10 YR 3/4	68	14	18	8.2
30"	3	10 YR 0/2	10 YR 5/4	52	24	24	8.3

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow Check #4

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	36	10 YR 5/3	10 UYR 3/2	72	24	4	8
6" 2/	24	10 YR 4/3	7.5 YR 3/2	44	38	18	7.8
12"	19	7.5 YR 5/4	10 YR 3/3	41	39	20	8.1
18"	18	10 YR 7/2	10 YR 6/3	63	24	8	8.3
24"	28	10 YR 7/1	10 YR 5/3	74	20	6	8.1
30"	27	10 YR 7/2	10 YR 5/4	78	20	2	8.3

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Windrow Check #5

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	25	10 YR 6/2	10 YR 3/2	68	28	4	8.3
6" 2/	19	10 YR 4/3	7.5 YR 3/2	58	24	18	7.8
12"	26	7.5 YR 5/2	5 YR 3/2	80	10	10	8
18"	31	10 YR 5/3	10 YR 3/3	86	8	6	8.2
24"	19	10 YR 6/2	7.5 YR 3/2	90	10	0	8.5
30"	33	10 YR 6/2	5 YR 3/2	94	2	4	8.5

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place #1

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	46	10YR 5/2	10 YR 3/2	68	28	4	7.7
6" 2/	31	10 YR 6/2	7.5 YR 3/2	46	32	22	7.7
12"	38	7.5 YR 4/2	7.5 YR 3/2	50	28	22	7.5
18"	46	10 YR 5/3	10 YR 3/3	68	30	12	8.1
24"	34	10 YR 5/2	7.5 YR 3/2	62	22	16	8
30"	38	10 YR 6/2	10 YR 3/4	74	14	12	8.3

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place #2

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	42	10 YR 5/2	7.5 YR 3/2	80	12	8	8
6" 2/	38	10 YR 5/3	10 YR 3/2	50	38	12	7.7
12"	46	10 YR 5/2	7.5 YR 3/2	44	40	16	7.9
18"	38	10 YR 5/2	10 YR 3/2	46	34	20	8.2
24"	49	10 YR 6/2	7.5 YR 3/2	50	32	18	8.3
30"	40	7.5 YR 6/2	7.5 YR 3/2	82	14	4	8.2

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place #3

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	33	10 YR 5/2	10 YR 3/2	72	26	2	8
6" 2/	31	10 YR 4/3	5 YR 3/3	58	20	22	7.8
12"	42	10 YR 5/2	10 YR 3/2	64	18	18	8.1
18"	36	10 YR 5/2	10 YR 3/4	64	26	10	8.1
24"	44	10 YR 6/2	10 YR 3/4	84	10	6	8
30"	41	10 YR 5/1	10 YR 3/2	80	12	8	7.9

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place #4

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	29	7.5 YR 6/2	10 YR 3/2	68	28	4	8.2
6" 2/	20	10 YR 5/3	10 YR 3/3	64	26	10	7.9
12"	26	10 YR 5/3	10 YR 4/3	66	24	10	8.1
18"	27	5 YR 6/2	5 YR 3/4	74	20	6	8
24"	17	5 YR 6/1	5 YR 4/3	64	12	24	8.3
30"	31	7.5 YR 6/2	5 YR 4/2	84	12	4	8.2

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place #5

Depth of Sample	Percent Rock 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	45	10 YR 4/2	5 YR 2/2	74	24	2	7.9
6" 2/	37	10 YR 4/2	10 YR 3/2	68	22	10	7.9
12"	39	5 YR 5/3	5 YR 3/2	68	22	10	7.9
18"	38	10 YR 6/2	5 YR 4/2	74	18	8	8
24"	37	5 YR 6/2	10 YR 3/3	82	14	4	8.3
30"	49	7.5 YR 6/2	5 YR 4/2	84	12	4	8.4

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place Check #1

Depth of Sample	Percent Rock > 2 mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	40	10 YR 4/2	10 YR 3/2	64	29	7	7.3
6" 2/	14	10 YR 4/3	10 YR 3/4	48	38	14	7.7
12"	23	10 YR 4/3	10 YR 3/4	50	38	12	7.7
18"	26	10 YR 5/3	10 YR 3/2	50	34	16	7.4
24"	28	7.5 YR 3/2	5 YR 4/2	53	34	11	8
30"	34	10 YR 5/3	10 YR 3/4	42	48	10	8

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-place Check #2

Depth of Sample	Percent Rock > 2mm (by weight	Color		Texture			pH (1:5
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	40	10 YR 4/2	10 YR 3/2	58	40	2	7.3
6" 2/	14	10 YR 4/3	10 YR 3/4	44	38	18	7.7
12"	23	10 YR 4/3	10 YR 3/4	46	36	18	7.7
18"	26	10 YR 5/3	10 YR 3/2	78	16	4	7.4
24"	28	7.5 YR 3/2	5 YR 4/2	42	36	22	8
30"	34	10 YR 5/3	10 YR 3/4	56	30	14	8

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place Check #3

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	42	10 YR 4/2	10 YR 3/2	64	18	18	8
6" 2/	31	10 YR 4/3	10 YR 3/3	58	26	16	7.7
12"	45	10 YR 4/2	7.5 YR 3/2	88	10	2	8.4
18"	40	10 YR 5/2	10 YR 3/2	90	8	2	8.3
24"	42	10 YR 4/2	10 YR 3/2	84	8	8	8.5
30"	44	7.5 YR 5/2	7.5 YR 3/2	94	0	6	8.1

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place Check #4

Depth of Sample	Percent Rock > 2 mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	37	10 YR 6/2	10 YR 5/2	65	27	8	8
6" 2/	45	10 YR 7/2	10 YR 5/3	51	36	13	8.1
12"	37	10 YR 7/2	10 YR 5/3	56	22	22	8.2
18"	56	10 YR 7/2	10 YR 4/3	44	34	22	8
24"	77	10 YR 7/2	10 YR 4/3	71	20	9	8.1
30"	96	10 YR 7/3	10 YR 4/4	78	16	6	8.2

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Milford

Runoff Plot: Debris-in-Place Check #5

Depth of Sample	Percent Rock > 2mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	% Silt	% Clay	
Surface 1/	44	10 YR 5/2	10 YR 3/2	92	4	4	8.1
6" 2/	49	7.5 YR 4/2	10 YR 3/2	84	12	4	7.8
12"	62	10 YR 5/2	5 YR 3/3	90	6	4	8.1
18"	29	10 YR 5/3	10 YR 3/3	28	66	6	7.7
24"	25	5 YR 4/4	5 YR 3/4	24	64	12	7.9
30"	18	10 YR 7/2	10 YR 4/3	52	38	10	8.1

1/ Range of 0.5% to approximately 7.0% organic matter in surface 6 inches; values generally ranged from 1.0% to 2.0%.

2/ Range of 0.7% to approximately 2.5% organic matter at depths of 6 inches to 30 inches; values generally ranged from 1.0% to 1.5%.

Soil Analysis Data

Blanding

Runoff Plot: Windrow #1

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	.13	5 YR 4/6	5 YR 3/3	56	38	6	8.0
6"	.10	5 YR 4/4	5 YR 3/4	50	38	12	7.9
12"	.09	5 YR 5/4	5 YR 4/4	42	44	14	8.2
18"	.10	5 YR 4/6	5 YR 3/4	38	50	12	7.7
24"	.10	5 YR 4/4	5 YR 3/4	42	40	18	8.3
30"	.10	5 YR 4/6	5 YR 4/4	46	38	16	7.9

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow #2

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color		% Sand	% Silt	%Clay	pH (1.5 paste)
		Dry	Wet				
Surface	trace	5 YR 4/6	5 YR 3/4	52	38	10	7.9
6"	.09	5 YR 4/6	5 YR 4/4	44	40	16	7.9
12"	.09	5 YR 5/6	5 YR 3/4	46	38	18	8.1
18"	.10	5 YR 5/6	5 YR 4/4	40	40	20	8.0
24"	.09	5 YR 5/4	5 YR 4/4	46	38	16	8.1
30"	trace	5 YR 5/6	5YR 4/6	52	26	22	8.2

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow #3

Depth of Sample[1/]	Percent Rock 2 mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	.12	5 YR 4/6	5 YR 4/4	62	32	6	8.0
6"	.10	5 YR 4/6	5 YR 3/4	46	44	10	7.9
12"	.11	5 YR 4/6	5 YR 4/4	46	38	16	8.0
18"	.12	5 YR 5/4	5 YR 4/4	56	26	18	7.8
24"	.09	5 YR 5/6	5 YR 4/4	44	40	16	7.9
30"	.11	5 YR 5/4	5 YR 4/6	44	38	18	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow #4

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color		%Sand	%Silt	%Clay	pH (1.5 paste)
		Dry	Wet				
Surface	trace	5 YR 4/4	5 YR 3/3	52	38	10	7.9
6"	.11	5 YR 5/6	5 YR 4/4	36	44	20	7.9
12"	.11	5 YR 6/6	5 YR 4/4	44	38	18	7.9
18"	Trace	5 YR 5/6	5 YR 4/6	46	36	18	8.0
24"	.11	5 YR 6/6	5 YR 4/6	62	38	0	8.1
30"	.01	5 YR 7/3	5 YR 5/6	58	28	14	8.1

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow #5

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color		%Sand	Texture		pH (1.5 paste)
		Dry	Wet		% Silt	%Clay	
Surface	.15	5 YR 5/4	5 YR 3/3	70	30	0	8.0
6"	.14	5 YR 4/6	5YR 3/4	74	26	0	7.7
12"	Trace	5 YR 5/6	5 YR 4/4	72	28	0	7.7
18"	.11	5 YR 5/6	5 YR 4/4	68	32	0	8.2
24"	.11	5 YR 5/6	5 YR 4/4	44	38	18	8.0
30"	.12	5 YR 5/6	5 YR 4/4	84	16	0	8.1

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow Check #1

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color		%Sand	Texture		pH (1.5 paste)
		Dry	Wet		%Silt	%Clay	
Surface	Trace	5 YR 4/6	5 YR 3/4	48	44	8	7.9
6"	Trace	5 YR 4/6	5 YR 3/4	50	32	18	7.5
12"	.21	5 YR 4/8	5 YR 3/4	58	26	16	8.1
18"	.01	7.5 YR 5/4	5 YR 3/4	50	36	14	7.9
24"	.14	5 YR 5/6	5 YR 4/4	62	28	10	8.3
30"	.16	7.5 YR 6/4	5 YR 4/6	48	36	16	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow Check #2

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color		%Sand	Texture		pH (1.5 paste)
		Dry	Wet		%Silt	%Clay	
Surface	Trace	5 YR 4/6	5 YR 3/4	40	54	6	8.0
6"	Trace	5 YR 4/4	5 YR 4/4	52	30	18	8.0
12"	.40	7.5 YR 6/4	5 YR 4/4	52	28	20	8.1
18"	.15	7.5 YR 6/4	5 YR 4/4	50	30	20	8.0
24"	.37	5 YR 5/6	5YR 3/4	50	32	18	8.1
30"	.13	7.5 YR 6/4	5 YR 4/4	48	35	17	8.2

1/Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow Check #3

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	Trace	5 YR 4/8	5 YR 3/4	72	28	0	8.0
6"	.01	5 YR 4/6	5 YR 3/4	64	36	0	8.0
12"	.08	5 YR 5/3	5 YR 4/4	54	32	14	8.2
18"	.09	5 YR 5/4	5 YR 4/4	46	38	16	8.2
24"	.08	7.5 YR 6/4	5 YR 5/4	64	24	12	7.9
30"	.08	7.5 YR 6/4	5 YR 4/4	58	28	14	8.2

1/Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow Check #4

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	Trace	5 YR 4/8	5 YR 3/4	58	34	8	7.7
6"	.04	5 YR 4/6	5 YR 3/4	44	36	20	7.7
12"	.15	7.5 YR 4/4	5 YR 3/4	42	44	14	7.6
18"	.01	7.5 YR 5/4	5 YR 4/4	44	40	16	7.8
24"	.14	7.5 YR 5/4	5 YR 4/4	44	38	18	8.2
30"	.13	5 YR 5/6	5 YR 3/4	46	38	16	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Windrow Check #5

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	Trace	5 YR 5/6	5 YR 3/4	64	28	8	7.9
6"	Trace	5 YR 4/6	5 YR 4/4	76	24	0	8.0
12"	.01	5 YR 4/6	5 YR 3/4	76	24	0	8.0
18"	Trace	5 YR 5/6	5 YR 4/4	66	34	0	8.0
24"	.10	5 YR 5/4	5 YR 4/4	46	40	14	8.0
30"	.08	5 YR 4/6	5 YR 3/4	70	30	0	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place #1

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	Trace	5 YR 5/6	5 YR 3/3	60	34	6	8.3
6"	.12	2.5 YR 3/6	2.5 YR 3/4	46	38	16	7.7
12"	.10	5 YR 4/6	5 YR 4/4	46	36	18	8.2
18"	.12	5 YR 4/6	5 YR 4/4	68	22	10	8.3
24"	.13	5 YR 5/6	5 YR 4/4	48	30	22	8.0
30"	.00	5 YR 7/3	5 YR 5/6	46	38	16	8.3

1/Mean percent organic matter for all plots at each depth is as follows: surface, 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place #2

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color			Texture		pH (1:5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	.12	5 YR 5/6	5 YR 5/6	62	34	4	7.9
6"	.12	5 YR 4/6	5 YR 3/4	42	48	10	7.7
12"	.09	5 YR 4/6	2.5YR 3/4	50	36	14	7.8
18"	.09	5 YR 4/8	5 YR 4/4	50	34	16	8.0
24"	.09	5 YR 4/6	5 YR 4/4	54	30	16	7.9
30"	.11	5 YR 4/6	5 YR 3/4	44	36	20	8.2

1/ Mean percent organic matter for all plots at each depth is as follows: surface, 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place #3

Depth of Sample[1/]	Percent Rock 2 mm (by weight)	Color		Texture			pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	Trace	5 YR 5/6	5 YR 3/4	66	32	2	8.0
6"	.16	5 YR 4/4	5 YR 3/3	56	32	12	7.4
12"	.15	5 YR 4/6	5 YR 3/4	50	36	14	7.7
18"	Trace	5 YR 4/4	5 YR 3/4	52	34	14	7.7
24"	.14	5 YR 4/6	5 YR 3/4	50	34	16	7.9
30"	.11	5 YR 4/6	5 YR 4/4	48	34	18	8.0

[1/] Mean percent organic matter for all plots at each depth is as follows: surface, 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place #4

Depth of Sample[1/]	Percent Rock 2 mm. (by weight)	Color		Texture			pH (1.5 paste)
		Dry	Wet	% Sand	%Silt	%Clay	
Surface	.15	5 YR 5/6	5 YR 3/3	62	34	4	7.8
6"	.13	2.5 YR 3/6	2.5YR 3/4	28	64	8	7.7
12"	.13	5 YR 4/4	5 YR 3/4	46	42	12	7.9
18"	.13	2.5 YR 3/6	2.5YR 3/4	52	34	14	7.9
24"	.13	5 YR 5/6	5 YR 4/4	48	28	28	8.0
30"	.09	5 YR 5/6	5 YR 4/6	62	38	0	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface, 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris in place #5

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color		Texture			pH (1:5 paste)
		Dry	Wet	% Sand	%Silt	%Clay	
Surface	.11	5 YR 5/6	5 YR 3/4	70	30	0	7.9
6"	.10	5 YR 4/6	2.5 YR 3/4	82	18	0	7.7
12"	.09	5 YR 4/4	5 YR 3/4	74	26	0	8.0
18"	.10	5 YR 4/6	5 YR 3/4	78	22	0	8.0
24"	.12	5 YR 4/4	5 YR 3/4	50	36	14	8.1
30"	.10	7.5 YR 6/2	5 YR 5/4	66	34	0	8.1

1/ Mean percent organic matter for all plots at each depth is as follows: surface, 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place Check #1

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color		%Sand	%Silt	%Clay	pH (1.5 paste)
		Dry	Wet				
Surface	.16	5 YR 5/6	5 YR 3/3	60	34	6	8.0
6"	.10	5 YR 4/6	5 YR 3/4	46	40	14	8.1
12"	.11	5 YR 4/6	5 YR 4/3	42	34	22	7.8
18"	Trace	5 YR 7/3	5 YR 5/4	44	30	26	8.3
24"	.12	5 YR 7/3	5 YR 5/4	46	30	24	8.2
30"	Trace	5 YR 7/4	5 YR 4/6	44	34	22	8.1

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place Check #2

Depth of Sample 1/	Percent Rock 2mm (by weight)	Color		%Sand	% Silt	%Clay	pH (1.5 paste)
		Dry	Wet				
Surface	Trace	5 YR 4/6	5 YR 3/4	48	50	2	7.8
6"	Trace	5 YR 4/6	5 YR 3/4	38	46	16	7.8
12"	.08	5 YR 4/4	5 YR 3/4	36	54	10	7.8
18"	.08	5 YR 4/6	5 YR 3/4	48	32	20	8.0
24"	.09	5 YR 5/4	5 YR 4/4	48	34	18	8.0
30"	.13	5 YR 7/3	5 YR 6/6	44	36	20	8.1

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place Check #3

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color		Texture			pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	Trace	5 YR 5/6	5 YR 3/4	58	34	8	8.0
6"	.11	5 YR 4/6	5 YR 3/4	56	42	8	7.8
12"	.11	5 YR 4/6	5 YR 3/4	54	32	14	7.5
18"	.10	5 YR 4/4	5 YR 3/4	50	38	12	8.1
24"	.12	5 YR 4/6	2.5YR 3/6	46	38	16	8.1
30"	.12	5 YR 5/6	5 YR 4/4	48	38	14	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place Check #4

Depth of Sample1/	Percent Rock 2 mm (by weight)	Color		%Sand	%Silt	%Clay	pH (1.5 paste)
		Dry	Wet				
Surface	.13	5 YR 5/6	5 YR 3/4	78	22	0	8.0
6"	.10	5 YR 4/6	5 YR 3/4	80	20	0	7.8
12"	.11	5 YR 4/6	2.5YR 3/6	44	46	10	7.6
18"	Trace	5 YR 5/4	5 YR 4/4	88	12	0	7.7
24"	Trace	5 YR 5/4	5 YR 4/6	52	36	12	7.8
30"	.10	5 YR 7/3	5 YR 6/4	68	32	0	7.9

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

Soil Analysis Data

Blanding

Runoff Plot: Debris-in-Place Check #5

Depth of Sample 1/	Percent Rock 2 mm (by weight)	Color			Texture		pH (1.5 paste)
		Dry	Wet	%Sand	%Silt	%Clay	
Surface	.01	5 YR 4/6	5 YR 3/3	68	32	0	8.0
6"	.03	5 YR 4/6	5 YR 3/4	56	34	10	8.0
12"	trace	5 YR 7/3	7.5YR 5/4	92	8	0	8.0
18"	trace	5 YR 7/3	5 YR 5/4	44	56	0	7.9
24"	.06	7.5 YR 7/4	7.5 YR 5/4	92	8	0	8.0
30"	trace	5 YR 7/3	5 YR 6/6	96	4	0	8.0

1/ Mean percent organic matter for all plots at each depth is as follows: surface 1.9% (Range 0.8% to 3.3%); 6 inches, 1.9% (range 0.9% to 2.6%); 12 inches, 1.9% (range 1.1% to 3.0%); 18 inches, 1.6% (range 0.6% to 2.7%); 24 inches, 1.7% (range 0.6% to 2.7%); 30 inches 1.6% (range 0.8% to 2.4%).

APPENDIX #2

Manuscripts

"Influence of a Soil Microfloral Crust on Hydrologic and Chemical Properties of Soils in Southeastern Utah."

and

"Microclimatic Measures on a Pinyon-Juniper Site. I. Net Radiation, Solar Radiation, Wind."

Influence of a Soil Lichen Crust on Hydrologic and Chemical Properties of Soils in Southeastern Utah [1/]

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[1/] Study conducted in cooperation with the Bureau of Land Management, contact 14-11-0008-2837. Journal paper , Utah Agricultural Experiment Station.

Abstract

Lichen crusts on soils within the Colorado Plateau were studied to determine their effect on infiltration rates, potential sediment production, permeability, and several chemical properties of the soil. Six different crust stages were identified. Undisturbed soil cores were used to determine intrinsic permeability under three treatments and disturbed soil samples were analyzed for pH, percent organic matter, soil texture, Ca+Mg content and total conductivity.

It was found that the lichen crust had little effect on soil chemical properties. Analysis of undisturbed soil core data indicates that high lichen cover tends to decrease intrinsic permeability; this effect was reinforced when cores were irrigated. Data obtained with the Rocky Mountain infiltrometer indicated that sites with any degree of lichen cover had significantly higher infiltration rates than chained areas (no lichen cover). Patterns of sediment production indicate a potential for increased sediment once the lichen crust has been disturbed.

Introduction

Research has shown that soil crusts formed by algae and other microflora influence infiltration and soil stability. Fletcher and Martin (6) found that crusts of molds and algae increase tensile strength of soil, reduce erosion, and increase organic matter. Booth (2) reported that algal crusts resist drought, prevent wind erosion, and serve to break the force of falling raindrops. Cameron and Blank (4) point out the importance of soil crusts in preventing erosion and in colonizing bare areas. Soil microflora can have effects on soil aggregation according to Bond (1).

The objective of this study was to evaluate the influence of a soil crust composed of crustose lichens on infiltration rates, potential sediment production, and several additional soil properties.

The lichen crust, as found in the Colorado Plateau, is almost continuous in its undisturbed condition. Many small lichen "pedestals" about three inches across characterize the crust; Lichen species found in the crust include Collema coccophorum, Dermatocarpon hepaticum, Fulgensia fulgens, Lecidea decipiens, Peccania kansasa. Lichen identifications were made by C. W. Wetmore. These species are predominately black in color giving the crust a dark, "bumpy" appearance.

Procedures

The study area is located forty-five miles west of Blanding in San Juan County, Utah, in the vicinity of Natural Bridges National Monument. Six conditions of the crust were sampled:

A. relict areas; crust undisturbed

B. grazed areas within the piñyon (Pinus edulus)-juniper (Juniperus osteosperma) woodland (protected since 1967) where the crust was still intact (near relict)

C. grazed areas within the pinyon-juniper woodland (protected since 1967) where the crust was in an intermediate stage of breakdown.

D. grazed areas within the pinyon-juniper woodland (protected since 1967) where the crust had been severely disturbed (animal pathways and waterways).

E. crust mechanically disturbed by double chaining (a large anchor chain is pulled behind two tractors, first in one direction and then in the opposite direction) pinyon-juniper and leaving the debris in place. The chaining treatment was applied in the fall of 1967.

F. crust mechanically disturbed by chaining the pinyon-juniper woodland and windrowing the debris. (This is a common range improvement technique used in the area.) The chaining treatment was applied in the fall of 1967.

Soil samples from three depths (0-1/2", 1/2-1", 1-2") were taken from sites representing each crust condition. Soil samples were analyzed for the following factors at each depth; texture (3), degree of aggregation (Bouyoucos (3), with Calgon omitted), Ca+Mg present, conductivity, pH and organic matter (7).

Thirty-six two-inch diameter soil cores were obtained from each crust condition. These cores were used to determine intrinsic permeabilities (7). Water was ponded over each core and a constant head was maintained. Total percolation through each core was measured at 5 minute intervals for a period of forty-five minutes. Before permeability runs were made, one-third of the cores from each site were subjected to one of the following treatments:

1. cores air dry prior to the run
2. cores wet to saturation daily for a period of ten days prior to

the run (cores air dry for 10 days prior to wetting treatment)

3. cores wet to saturation every five days for a period of two months prior to runs

Infiltration and sediment production measurements were made for each crust condition using a Rocky Mountain infiltrometer (7). Seventy-two infiltrometer runs, each 28 minutes in length, were made (12 replications per crust condition). Plots were prewet and soils allowed to drain to field capacity by waiting a minimum of 2 hours. Pooled sediment production samples were taken, i.e. turbidity of runoff was averaged over all time periods. Infiltrometer runs were made during the first 2 weeks of June, 1971.

Results and Discussion

Average values for all measurements regarding each crust condition are given in tables 1 and 2. ~~and 3.~~

Soil Properties

Soil properties were not strongly influenced by the soil crust. Organic matter (overall average, .42%) and pH (overall average, 7.29) analyses showed no significant differences among crust conditions or soil depths. Significant differences were found in analysis of particle size distribution, Ca+Mg content, total conductivity, and water stable aggregates less than 2 mm. diameter. These differences can be attributed to differences caused by mechanical disturbance during chaining activities.

a. Texture

Averaged over all depths, sand percentages were significantly higher in the chained with windrowing treatment (see table 1). Wind, as a sorting agent, is more effective in this area and as a result has probably deleted

the silt fraction slightly. The remaining crust conditions did not show this effect since their surfaces were protected by lichen cover and/or pinyon-juniper woodland of debris. Silt percentages, averaged over all depths, were likewise significantly different; sites A and B were significantly higher in silt than the remaining sites. Clay percentages, averaged over all depths, were significantly lower in sites A and B than the other sites.

The clay fraction was influenced somewhat by soil depth. Averaged over all crust conditions, the two inch depth showed significantly greater clay content than the other two depths. This may indicate some mobilization and translocation of clays to lower depths.

b. Physical and Chemical Properties:

Averaged over all depths, Ca+Mg content was found to be significantly higher in the chain with windrowing treatment area and in the relict stand (Site A). Total conductivity (averaged over all depths) was also significantly higher in the chain and windrowed area than in the remaining sites.

The windrowing treatment involves disturbance and mixing of the soil to a depth of from 4 to 6 inches. The ion-rich caliche layer which is present at a shallow depth in this geographic region was disturbed and mixed with the surface soil during mechanical treatment; this probably accounts for the higher Ca+Mg content and higher total ion content found in this crust condition.

Averaged over all crust conditions, soil depths 1.5 inches and 2 inches were significantly higher in Ca+Mg and in total conductivity than was depth .5 inch. This indicates there has been some leaching of ions since treatments were applied.

Organic matter was not significantly different among sites or depths.

c. Water Stable Aggregates:

Water stable aggregates less than 2 mm diameter were found to be significantly higher in the chain with windrowing treatment (averaged over all depths). Averaged over all crust conditions, depth 2 inches also showed a significant increase in stable aggregates. This can be explained by the above-mentioned increase in total ions and Ca+Mg content due to mechanical mixing at site F and probable leaching phenomenon at depth 2 inches.

Intrinsic Permeability

Crust condition and treatment influenced intrinsic permeability. High lichen cover significantly impeded permeability; in general, the greater the lichen cover, the greater the resistence to percolation. Intrinsic permeability did not vary significantly between time periods. Significant differences were found among sites with appreciable lichen cover (Sites A, B, C) and those which were nearly bare of lichen cover (see table 2.). Highest percolation rates occurred within cores from sites with very low lichen cover; lowest values occurred in cores with greatest lichen cover.

The two irrigation treatments (see Procedures) significantly decreased intrinsic permeability of cores as compared with cores not irrigated. Addition of water simulates conditions of the lichen crust during favorable moisture periods. Irrigation reinforces the tendency of high lichen cover to impede percolation.

Infiltration and Sediment Production

Infiltrometer runs indicated that high lichen cover significantly increases infiltration rates. Sites with any degree of lichen cover (sites A, B, C) showed significantly higher infiltration rates as compared with

Table 2. Average infiltration rates (cm/hr) during various time periods (minutes) for each cryptogamic crust condition.

Site	Time Period (Minutes)[1/]				
	3-8	8-13	13-18	18-23	23-28
A (relict)	9.3 ac	8.1 a	7.2 ac	6.4 ac	6.3 ac
B (near relict)	10.5 a	8.1 a	6.8 ac	5.4 bc	5.2 ac
C (intermediate condition)	8.8 bc	8.2 a	7.6 a	7.6 a	6.7 a
D (waterways)	10.4 ac	7.5 ac	7.5 a	6.2 ac	6.0 ac
E (chained-with-debris-in-place)	8.2 bd	6.3 bd	5.8 b	5.3 bc	5.0 bc
F (chained-with-windrowing)	8.3 bd	5.9 bd	4.7 b	4.6 bd	3.8 bd

[1/] Any two means in the same column with the same combination of letters are not significantly different at the .05 level of probability.

both of the chained areas where lichen cover has largely been destroyed. There were no significant differences among unchained sites (A, B, C, D), but all were significantly different from the chained sites (E, F). Lichen pedestals help prevent surface sealing of soil pores and they also create some detention and retention storage on the plots, thus increasing infiltration.

Site D (pathways and waterways) appears to be a special case in regard to infiltration rate. It is an apparent exception to the generalization that presence of any degree of lichen cover enhances infiltration. There are several plausible reasons for this inconsistency. Infiltration measurements were taken in the spring of 1971 when the frost heaving effects of the past winter were still very much in evidence. In this arid region, soil moisture accumulates during the winter months and resultant frost heaving causes pronounced "fluffing-up" of the soil and thus increased friability and decreased bulk density. Past experience has shown that increased infiltration rates are to be expected in spring and early summer due to these effects. With this in mind, one could speculate that once summer thunderstorms cause flow in the waterways, the apparently high spring infiltration rate would be reduced.

Infiltration rates among the different crust conditions remained in the same positions relative to one another throughout the infiltrometer runs (e.g., a site with higher infiltration rate comparated to another at the beginning of the infiltrometer run tended also to have a higher rate at the end of the run; see fig. 2 and Table 4). Effect of very high lichen cover (sites A and B) on infiltration rates was greatest early in the infiltrometer runs (see fig. 2).

Averaged over all sites, successive time periods all differed significantly;

the first five-minute period showed highest infiltration rates and the rates decreased with each successive period.

Differences in sediment production among the crust conditions were not significant although a general pattern was indicated. The trend was toward increased sediment once the crust had been in any way disturbed. Degree of disturbance seemed to matter little in regard to sediment production (see fig. 3).

Conclusions

1. The lichen crust has little direct effect on the soil chemical and physical properties considered.

2. High lichen cover (sites A, B, C) caused a decrease in intrinsic permeability; this effect was reinforced when the cores were irrigated.

3. Appreciable lichen cover promotes increased infiltration as compared with soil surface conditions that result from chaining.

4. Patterns of sediment production data indicate an increase in sediment production once the crust has been disturbed.

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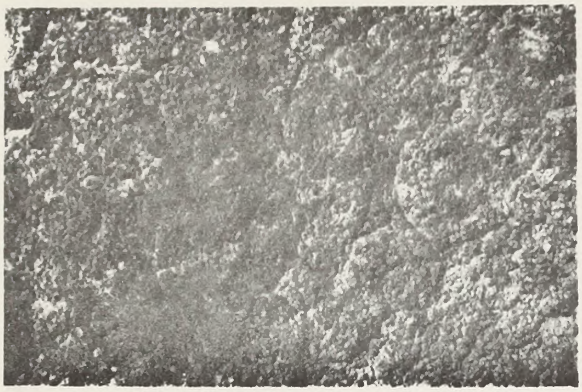
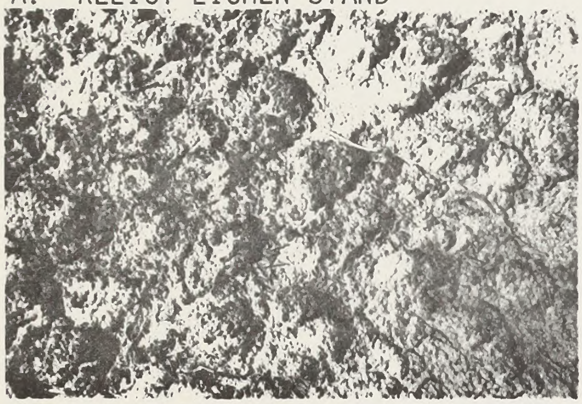


A. RELICT LICHEN STAND



B. NEAR-RELICT STAND WITHIN FORMERLY GRAZED AREA

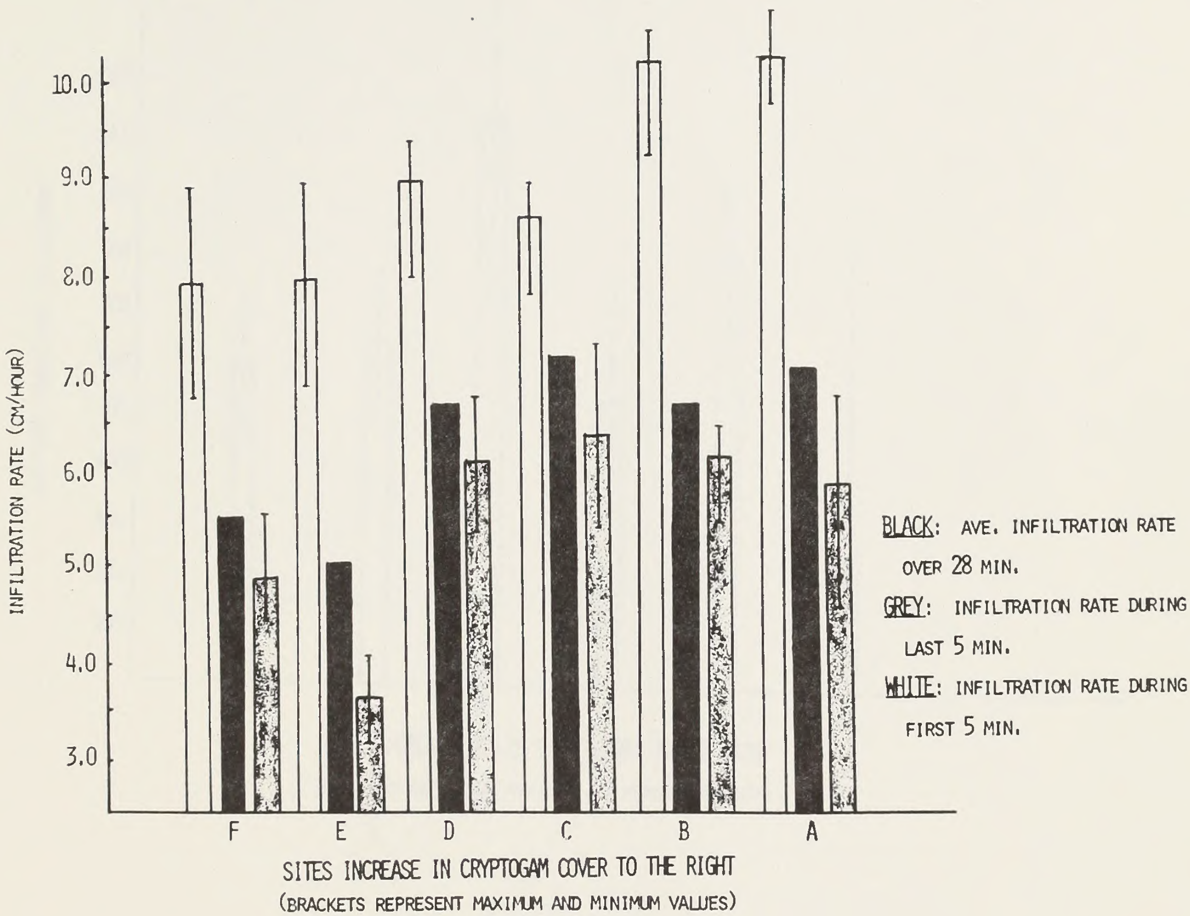
C. INTERMEDIATE BREAKDOWN OF THE CRUST WITHIN FORMERLY GRAZED AREA

D. PATHWAYS AND WATERWAYS

E. CHAINED WITH DEBRIS LEFT IN PLACE

F. CHAINED WITH DEBRIS WINDROWED

Figure 1.



10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
INFILTRATION RATE (CM/HOUR)
F
E
D
C
B
A
SITES INCREASE IN CRYPTOGAM COVER TO THE RIGHT
(BRACKETS REPRESENT MAXIMUM AND MINIMUM VALUES)
BLACK: AVE. INFILTRATION RATE OVER 28 MIN.
GREY: INFILTRATION RATE DURING LAST 5 MIN.
WHITE: INFILTRATION RATE DURING FIRST 5 MIN.

Figure 2.

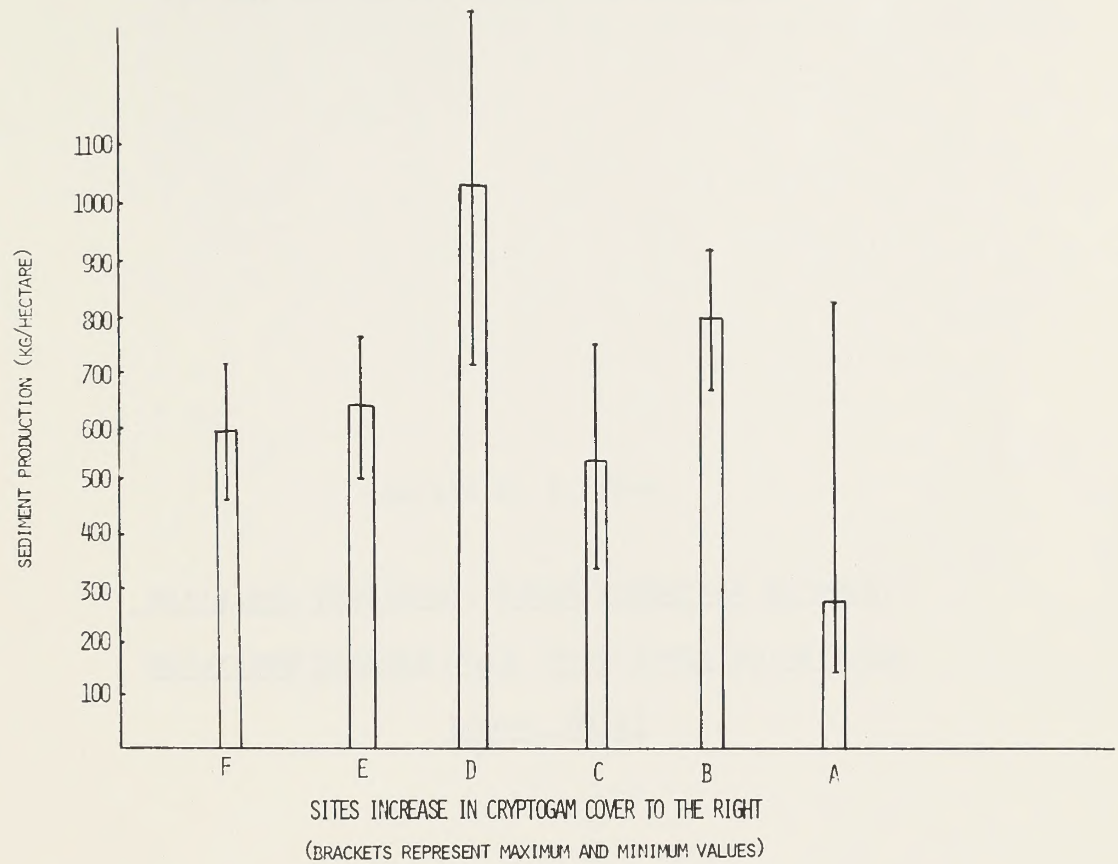

SEDIMENT PRODUCTION (KG/HECTARE)
1100
1000
900
800
700
600
500
400
300
200
100
F
E
D
C
B
A
SITES INCREASE IN CRYPTOGAM COVER TO THE RIGHT
(BRACKETS REPRESENT MAXIMUM AND MINIMUM VALUES)

Figure 3.

Microclimatic Measures on a Pinyon-Juniper Site

I. Net Radiation, Solar Radiation, Wind [1/]

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MICROCLIMATIC MEASURES

Footnotes

1/ This study was conducted in cooperation with the Bureau of Land Management under contract 14-11-0008-2837. Journal Paper 1241, Utah Agricultural Experiment Station, Utah State University, Logan.

Highlight

The microclimatic variables net radiation, solar radiation, and wind were studied during parts of 1968 and 1969 on a pinyon-juniper site in southwestern Utah. Treatments studied included chaining-with-debris windrowed, chaining-with-debris-in-place, and undisturbed woodland. Net radiation was greatest over the natural pinyon-juniper stand; Net radiation on the chain-with-windrow treatment and chain-with-debris-in-place treatment averaged 71 and 91 percent, respectively, of that measured on control plots. Albedo values averaged 13 and 12 percent for the 2 years on control plots, 21 and 19 percent on the chain-with-windrow treatment, and 13 and 14 percent on the chain-with-debris-in-place treatment. Roughly 3 miles of wind (as measured at approximately mid-canopy height) occurred on the chained treatments for every 1 mile measured on the control plots.

The pinyon-juniper (Pinus spp.-Juniperous spp.) type extends over approximately 60 million acres in the western United States (Dortignac, 1960). Of that amount, several hundred thousand acres have been altered through various tree removal techniques devised by the Bureau of Land Management and the Forest Service. The trees have been removed by chaining, burning, bulldozing, or spraying and either a grass species was artifically seeded on the site or the native species (shrubs and grasses) were allowed to naturally seed and eventually occupy the site.

Little is known about natural or undisturbed pinyon-juniper ecosystems, let alone those systems in which some form of vegetation manipulation has taken place. This study was designed to provide some preliminary information regarding microclimatic changes that may occur when pinyon-juniper sites are significantly altered by tree removal. The study site is located about 40 miles southwest of Milford in southwestern Utah.

Methods and Site Description

The study site was chained (using a large anchor chain between two tractors) in the fall of 1967. Three chaining treatments were used: chaining with all debris windrowed (crested wheatgrass (Agropyron cristatum) drill seeded at 8 lbs./acre); double chaining with debris-in-place (crested wheatgrass broadcast seeded at 8 lbs/acre); and no chaining. Approximately 30 to 40 acres were involved in each treatment. All treatments were fenced to exclude livestock.

Vegetation on the control plots was characterized by a 20 to 45 percent canopy coverage of pinyon and juniper trees. Shrub cover was variable and consisted of big sagebrush (Artemisia tridentata), black sagebrush (Artemisia nova), and small rabbitbrush (Chrysothamnus spp.). Scattered

plants of Eriogonum spp., Aster spp., and Salsola kali were also present. Vegetation on the chain-with-windrowing treatment was limited during the duration of this study; crested wheatgrass seedlings were the dominant species present. Seedling canopy coverage was less than 10 percent during 1968 and from 10 to 20 percent during 1969. On the chain-with-debris-in-place plot, the crested wheatgrass seedling canopy coverage was less than 10 percent during both 1968 and 1969, and shrub canopy coverage (all species) was 15 percent or less during both years.

Soils are silty loam in texture and were derived from basaltic parent materials.

During the summer of 1968 climatic stations were established in each of the three treatments. Net radiation was measured at 20 feet above the ground surface in the undisturbed and chained-with-debris-in-place treatments and at 8 feet above the ground surface in the chained-with-windrowing treatment. For radiometers mounted 20 feet about the soil surface, nine-tenths of the field of view is within a diameter of 115 feet (Reifsnyder and Lull, 1965). A Fritschen (1963) type miniature net radiometer, as modified by Campbell, Ashcroft and Taylor (1964), was used to make the net radiation measurements. Measurements were recorded on a Rustrak Model 88 12 v dc MA recorder with an unregulated motor. The radiometers (and all other instruments) were not moved about, but remained at or very near the same position for the duration of the study (Figures 1, 2, 3). The net radiation measured is the difference between the downward flux, consisting of direct and diffuse solar radiation and atmospheric thermal radiation, and the upward flux, consisting of reflected solar and thermal radiation and emitted thermal radiation.

Incoming and reflected solar radiation was measured with a Sol-A-Meter

(silicon cell) from the Yellot Solar Energy Laboratory. Dirmhirm (1968) has discussed the use of this instrument in radiation studies. A single Sol-A-Meter measured incoming solar radiation in the open at a height of approximately 6 feet. All measures of reflected shortwave radiation were made at the same height above the soil surface as the net radiation measures. Measurements were recorded on a Rustrak Model 88 12v dc MV recorder with an unregulated motor.

Wind was measured at a height of 11 feet (roughly mid-canopy height) with Science Associates Model 9924A totalizing anemometers.

Results and Discussion

net radiation

Net radiation values for each chaining treatment are shown in Figure 4 for the period 8-24-68 to 9-22-68. Data for the control treatment were available only for the period 9-7-68 to 9-22-68.

Highest net radiation values were measured over the control treatment, followed by the chain-with-debris-in-place treatment. The chain-with-windrow treatment gave the lowest net radiation values. Net radiation in the chain-with-windrow treatment averaged 71 percent (range was 48 to 85 percent) of that measured on the control plot. Net radiation on the chain-with-debris-in-place treatment averaged 91 percent (range was 80 to 105 percent) of that measured on the control plot.

The above results are somewhat expected. The net radiation (R_n) of a surface is the algebraic sum of the downward flux of solar radiation ($R_s\downarrow$) from sun and sky, the downward infrared or thermal radiation flux ($R_i\downarrow$) from the atmosphere, and the upward flux of reflected solar radiation ($R_s\uparrow$), and the upward infrared radiation flux ($R_i\uparrow$) from the surface.

Thus:

$$R_n = R_s\downarrow + R_i\downarrow - R_s\uparrow - R_i\uparrow \quad . \qquad (1)$$

The downward fluxes $R_s\downarrow$ and $R_i\downarrow$ are controlled by atmospheric conditions and are usually rather constant except under partly cloudy skies. The magnitude of $R_s\uparrow$ is dependent on the reflective properties of the surface, the ratio of outgoing (reflected) solar radiation to that incoming being refered to as the albedo (a). Thus:

$$R_s\uparrow = aR_s\downarrow \quad . \qquad (2)$$

The flux of $R_i\uparrow$ is dependent primarily on radiation emitted by the surface, but the reflected part of the downward infrared radiation is also included. Using the absorptivity or emissivity ϵ, the Stefan-Boltzmann constant σ, and the fact that surface temperature (T_o) governs radiation emitted by the surface, then

$$R_i\uparrow = \epsilon\sigma T_o^4 + (1-\epsilon)\, R_i\downarrow \quad . \qquad (3)$$

If we can assume that $\epsilon = 1$ (usual range 0.95 to 0.98 for natural surfaces), then combining and rearranging (1), (2), and (3) gives

$$R_n = (1-a)\, R_s\downarrow + R_i\downarrow - \sigma T_o^4. \qquad (4)$$

Examination of (4) will show that net radiation is dependent on the albedo and surface temperature if downward components ($R_s\downarrow$, $R_i\downarrow$) are somewhat constant. These conditions were closely approximated in this study. It will be seen later that albedo of the chain-with-windrow treatment was considerably higher than that measured on the other two treatments. Presence of debris scattered about on the debris-in-place treatment would tend to reduce the albedo, as would the presence of standing trees.

Influence of surface temperature differences on net radiation in this study is not known at this time, but Federer (1968) has found in the

Northeastern states that variations in surface temperature and albedo were about equally important in affecting net radiation. Baumgartner (1965) and Tromble and Simanton (1969) have found that net radiation values over open areas may be only about 60% of that measured over a forest canopy. Tajchman (1971) found that total net radiation over a spruce forest in Germany was 20% greater than that over alfalfa and 16% greater than that over potatoes.

solar radiation

Values for incoming and reflected shortwave are shown in Figure 5. Data were available for parts of both 1968 and 1969. During the 1968 measurement period the albedo of the chain-with-windrow treatment averaged 21 percent (range of 16 to 26 percent), or not quite twice the albedo of the chain-with-debris-in-place treatment (average 13 percent, range 7 to 20 percent) and control treatment (average 13 percent, range 9 to 21 percent).

The above relationship held for the 1969 measurements also. Albedo of the chain-with-windrow treatment averaged 19 percent (range of 12 to 25 percent) as compared with 14 percent for the chain-with-debris-in-place treatment (range of 9 to 23 percent) and 12 percent for the control treatment (range of 4 to 22 percent). Some slight changes are to be expected as vegetation increased somewhat on both of the chaining treatments.

Figure 6 gives some idea of the magnitude of change in reflected solar radiation which may be expected following a snow storm. No data are available for incoming solar radiation. The increased reflectivity in response to snow is greatest in the chain-with-windrow treatment, intermediate in the chain-with-debris-in-place treatment, and least in the control treatment.

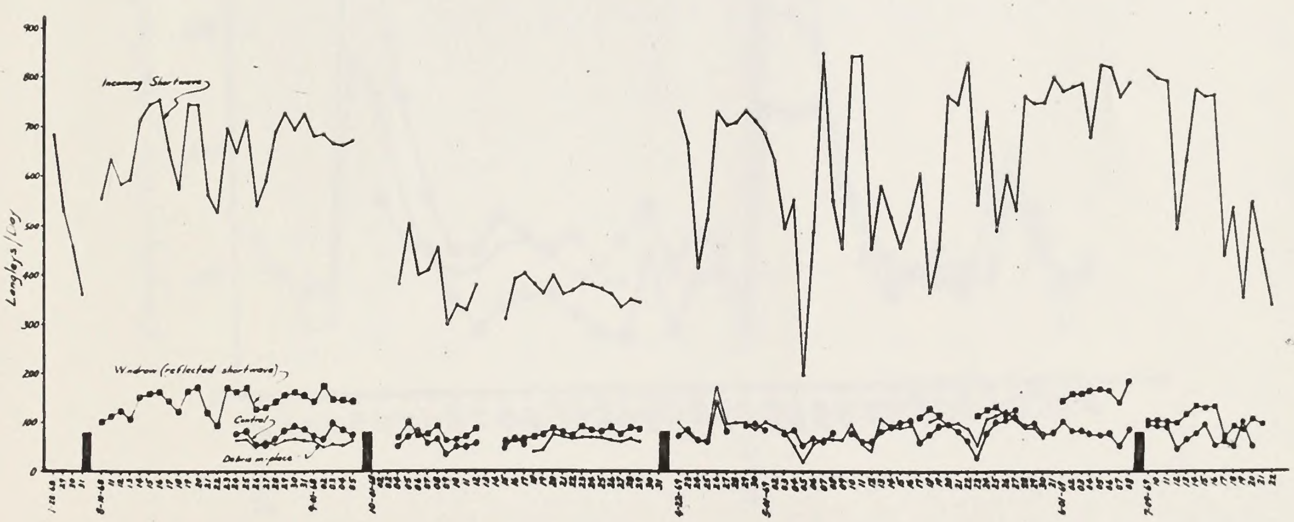
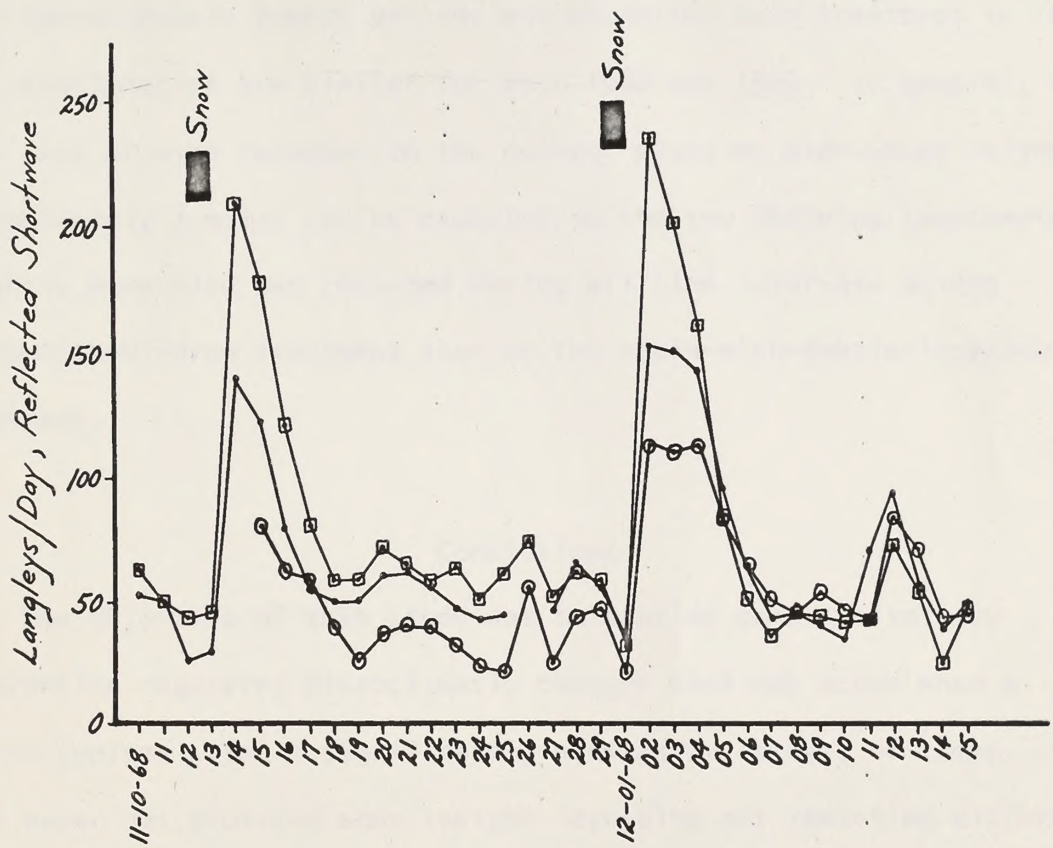

900
800
700
600
500
400
300
200
100
0
Langleys/Day
Incoming Shortwave
Windrow (reflected shortwave)
Control
Debris in-place

Figure .


Langleys/Day, Reflected Shortwave
250
200
150
100
50
0
Snow
Snow
11-10-68
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
12-01-68
02
03
04
05
06
07
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11
12
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15

Figure .

Results of both net radiation and albedo measurements agree closely with those of Hornbeck (1970) who compared the radiant energy of clearcut and forested sites in West Virginia.

Wind

Average miles of wind per day at mid-canopy height as averaged over approximately 2-week periods are shown for each treatment in Table 1. The relationships are similar for both 1968 and 1969. In general, for each mile of wind recorded on the control plots at mid-canopy height, approximately 3 miles can be expected on the two chaining treatments. Slightly more wind was recorded during all time intervals on the chain-with-windrow treatment than on the chain-with-debris-in-place treatment.

Conclusions

The objective of this study was to provide some preliminary information regarding microclimatic changes that may occur when a pinyon-juniper site is significantly altered by removal of trees. This paper has provided some insight regarding net radiation differences, albedo differences, and wind relationships.

Net radiation measurements were greatest over the natural pinyon-juniper woodland. Net radiation on the chain-with-windrow treatment and chain-with-debris-in-place treatment averaged 71 and 91 percent, respectively, of that measured on the control plot. Part of the difference is due to a higher albedo on the chain-with-windrow treatment.

Average albedo values varied only slightly during measurement periods in 1968 and 1969. Albedo values averaged 13 and 12 percent, respectively,

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for the 2 years on control plots, 21 and 19 percent on the chain-with-windrow treatment, and 13 and 14 percent on the chain-with-debris-in-place treatment. Presence of debris on the ground in the debris-in-place treatment tended to bring albedo values close to those measured on control plots, at least during snow-free periods. Following a snow storm, the amount of reflected solar radiation increased most on the chain-with-windrow treatment and least on the control treatment.

As might be expected, wind (as measured at approximately mid-canopy height) was greatest where standing trees were absent. Roughly 3 miles of wind occurred on the chained treatments for every 1 mile measured on the control plots.

Table 1. Summary of wind measurements at Milford Study Site.

Time Interval	Number of Days	Average Miles of Wind per Day [1/]		
		Control	Chain, Windrow	Chain Debris-in-Place
7-14-68 to 7-27-68	13	48	144	118
7-27-58 to 8-9-68	13	32	111	97
8-9-68 to 8-23-68	14	75	210	175
8-23-68 to 9-6-68	14	42	142	137
9-6-68 to 9-20-68	14	60	181	163
9-20-68 to 10-3-68	13	38	148	142
10-3-68 to 10-18-68	15	51	160	144
10-18-68 to 11-1-68	14	30	119	111
11-1-68 to 11-14-68	13	40	149	136
11-14-68 to 11-30-68	16	34	136	121
4-4-69 to 4-21-69	17	45	---	141
4-21-69 to 5-2-69	11	64	195	174
5-2-69 to 5-17-69	15	41	156	144
5-17-69 to 5-30-69	13	51	166	153
5-30-69 to 6-12-69	14	43	140	117
6-12-69 to 6-25-69	13	36	131	119
6-25-69 to 7-11-69	16	61	185	161

1/ At 11.5 feet (approximately mid-canopy height) above the ground surface.

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Figure Titles

Fig. 1. Instrumentation on control plot in the pinyon-juniper type.

Fig. 2. Instrumentation on chain-with-debris-in-place treatment.

Fig. 3. Instrumentation on chain-with-windrow treatment.

Fig. 4. Net radiation as measured on various dates over each treatment.

Fig. 5. Incoming and reflected solar radiation.

Fig. 6. Reflected solar radiation on the three treatments following two periods of snow. Squares represent the windrow treatment, circles the control treatment, and dots the chain-with-debris-in-place treatment.